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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

August 14, 1996

MEMORANDUM

SUBJECT: Request for Review of Three Cannery Bioassay Reports

TO: Vance Fong, Chief
Quality Assurance Section (P-3-2)

FROM: Pat Young Pat
American Samoa Program Manager
Office of Pacific Island Programs (E-4)

We would appreciate your staff's review of three bioassay reports conducted for the American Samoa canneries' NPDES and ocean disposal permits. The reports are as follows:

1. Joint Cannery Ocean Dumping Studies in American Samoa, CH2MHill & Glatzel & Associates, July 1996. (Note this report consists of three bioassay reports and ocean disposal model evaluation. We are requesting review of only the third bioassay study (June 1995), as the two prior studies were reviewed previously.)

2. Bioassay Testing of Effluent, February 1996 (Delayed Fall Sept/Oct. 1995) Sampling, CH2MHill and Glatzel & Associates, August 9, 1996.

3. Bioassay Testing of Effluent, March 1996 Sampling, CH2MHill and Glatzel & Associates, August 9, 1996.

Please call me if you or your staff have any questions regarding these reports. We would like to have these reports reviewed within the next four weeks if possible. Thanks for your help.

cc: Allan Ota, W-3-2

CH2MHILL

TECHNICAL MEMORANDUM

PREPARED FOR: StarKist Samoa, Inc.
VCS Samoa Packing Company, Inc.

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen A. Glatzel/Glatzel & Associates

DATE: 9 August 1996

SUBJECT: **Bioassay Testing of Effluent**
March 1996 Sampling

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the effluent bioassay testing of the Joint Cannery Outfall effluent sample that was collected in March 1996. This is the seventh of the required semi-annual tests. Separate technical memoranda are being prepared to describe the results of concurrent effluent chemistry testing.

Study Objectives

Section D.1 of the StarKist Samoa and VCS Samoa Packing NPDES permits requires that semi-annual definitive acute bioassays (96-hour static bioassays) be conducted on the cannery effluent. The purpose of these bioassays is to determine whether, and at what effluent concentration, acute toxicity may be detected for the effluent.

U.S. EPA has conducted a number of reviews of the effluent sampling, analysis, and bioassay tests. All comments from U.S. EPA have been incorporated into either the Standard Operating Procedures or have been incorporated into the procedures by the laboratory doing the test, Advanced Biological Testing, Inc., as documented in previous reports.

The bioassays were originally specified to be conducted using the white shrimp, *Penaeus vannami* (postlarvae). In the event *Penaeus vannami* are not available at the time of the tests, a substitute species, *Mysidopsis bahia*, has been approved by U.S. EPA (CH2M HILL, 26 January 1995). A substitution was not necessary for the March 1996 sampling, and *Penaeus vannami* were used.

The acute bioassay effluent sampling must be concurrent with effluent sampling for priority pollutant chemical analysis. Effluent samples are to be collected as 24-hour composite

samples. The effluent acute bioassay was conducted using a combined composite effluent sample made up from the composite effluent samples from the StarKist Samoa and VCS Samoa Packing facilities, as approved by EPA. This combined effluent bioassay is representative of the wastewater discharged from the joint cannery outfall to Pago Pago Harbor.

Effluent Sampling Methods

Between 1200 on March 13 and 0900 on March 14, 1996, 24-hour, flow-weighted, composite samples of final effluent were collected from both the StarKist Samoa and VCS Samoa Packing treatment plant discharges. Samples were collected from the established effluent sampling sites following the routine composite sample collection schedule for the plants. Detailed sampling procedures were provided in the March 1995 technical memorandum as Attachment II.

A total of eight grab samples were collected into pre-cleaned 1-gallon plastic cubitainers at each plant. Samples were collected at approximately three-hour intervals over a 24 hour period. The samples were stored on ice until the completion of the 24-hour sampling period. After all samples were collected a flow-proportioned composite sample was prepared. The grab sample collection times and the relative effluent volumes calculated from plant flow records are summarized in Table 1. The relative effluent volumes were used to prepare the final composite sample, which was used to fill the sample container shipped to the laboratory for testing.

A 5-gallon cubitainer containing the composite sample was packed on ice in an ice chest for shipment to the laboratory. Sample chain of custody forms were completed and then sealed into zip-lock bags and taped inside the lid of the ice chest. Samples were shipped via DHL on flights from Pago Pago to Honolulu and then to San Francisco. Samples were delivered to the testing laboratory on 18 March 1996.

Bioassay Testing Procedures

The bioassay tests were conducted by Advanced Biological Testing Inc., Tiburon, California. The testing procedures and results of the bioassay tests are provided in "*Results of a Bioassay Conducted on an Effluent Sample from the Joint Cannery Outfall in American Samoa using Penaeus vannami* " dated 1 April 1996 and included as Attachment I. This report summarizes the 96-hour acute bioassay test conducted with reference to U.S. EPA (1991) document *EPA/600/4-90/027* as the source of methods for conducting the test.

The bioassay tests were conducted considering and including U.S. EPA's comments on previous bioassay tests, as documented in previous reports. A brine control was run and a comparison was made with the dilution water "laboratory control". The test organisms were required to be 1 to 5 days old, with a 24-hour range in age and that test temperature be 20 $\pm$ 1 °C or 25 $\pm$ 1 °C. The penaeids were postlarvae (8 to 10 mm) tested at 20 $\pm$ 1 °C.

Because of the demonstrated potential for a lethal immediate dissolved oxygen demand (IDOD), discussed and documented in previous technical memoranda describing the first two bioassay tests, each bioassay test chamber was continuously aerated during the bioassay tests to maintain adequate levels of dissolved oxygen (DO). Bioassay tests were carried out for effluent concentrations of 50, 25, 12.5, 6.25, and 3.1% as vol:vol dilutions in seawater. Water quality was monitored daily with parameters measured including DO, pH, salinity, temperature, and ammonia. Additionally, a reference toxicant of sodium dodecyl sulfonate (SDS) was made up of a 2-gram per liter stock solution in distilled water and run at concentrations of 100, 50, 25, 12.5, and 6.25 mg/L in 30 ppt seawater for a 96-hour test.

Results

The results of the bioassay tests are summarized as follows:

> ***Penaeus vannami* Effluent Bioassay.** All results from the bioassay tests are included in Attachment I. The results of the penaeid bioassay tests indicate the LC_{50} for the effluent tested was 44.4 percent. The No Observable Effects Concentration (NOEC) for the 96-hour bioassay was 25 percent and the Least Observable Effects Concentration (LOEC) was 50 percent. The calculated value of toxicity units (TU) was 4.
>
> ***Penaeus vannami* Reference Toxicant Bioassay.** The reference toxicant had a LC_{50} of 42.9 mg/l. The laboratory mean was 26.39 mg/l with the data falling within two standard deviations of the laboratory mean, indicating normal to slightly lower than normal sensitivity.

Discussion

Table 2 summarizes the results of the effluent bioassay tests for the samples collected in the March 1996 sampling compared to the previous bioassay tests. The NOEC and LC_{50} are within the range obtained for previous penaeid tests. The penaeid survival in this test compares well to the survival of penaeids in February 1996 test.

Conclusions

The bioassay tests for the Joint Cannery Outfall effluent for March 1996 are not considered to be of concern. As discussed in the previous bioassay test reports on the effluent, the time scale of the mixing of the effluent with the receiving water is on the order of minutes to seconds to achieve dilutions that will eliminate possible toxic effects as reflected by the bioassay results. For example, an NOEC of 25% in this test corresponds to a dilution of 4:1 which is achieved in a few seconds. The discharge is located in about 180 feet of water and the effluent toxicity tests indicate that the discharge is diluted to non-toxic levels immediately after discharge and well within the initial dilution plume.

Table 1
StarKist Samoa and VCS Samoa Packing 24-hour Composite Effluent Sample for Bioassay Testing
13-14 March 1996

Grab Sample Number	VCS Samoa Packing		StarKist Samoa		VCS Samoa Packing Percent of Total Flow	StarKist Samoa Percent of Total Flow
	Sampling Date and Time	Effluent Flow Rate (mgd)	Sampling Date and Time	Effluent Flow Rate (mgd)		
1	3/13/96 1200	0.56	2/1/96 1200	1.19	3.7	8.0
2	1500	0.52	1500	1.26	3.5	8.4
3	1800	0.52	1800	1.26	3.5	8.4
4	2100	0.50	2100	1.33	3.3	8.9
5	2400	0.52	2400	1.36	3.5	9.1
6	3/14/96 0300	0.60	2/2/96 0300	1.40	4.0	9.4
7	0600	0.60	0600	1.05	4.0	7.0
8	0900	0.52	0900	1.75	3.5	11.7
Total		4.34		10.6	29.0	70.9
Mean		0.54		1.33		

Table 2
StarKist Samoa and VCS Samoa Packing
Combined Effluent Bioassay Results

Date	*Species*	Parameters		
		LC 50	**NOEC**	**LOEC**
2/93	*Penaeus vannami*	4.8%[1]	3.1%	6.25%
10/93	*Penaeus vannami*	15.67%	3.1%	6.25%
2/94	*Penaeus vannami*	15.76%	<1.6%	1.6%
10/94	*Mysidopsis bahia*[2]	31.2%	25%	50%
3/95	*Penaeus vannami*	14.8%	6.25%	12.5%
3/95	*Mysidopsis bahia*[3]	10.8%	6.25%	12.5%
2/96	*Penaeus vannami*	>50%	>50%	>50%
2/96	*Mysidopsis bahia*[3]	28.36%	12.5%	25%
3/96	*Penaeus vannami*	44.4%	25%	50%

[1]The February 1993 samples were not aerated until after the first day of the test. For subsequent tests the samples were aerated for the entire duration of the tests.
[2]*Mysidopsis bahia* substitutes as *Penaeus vannami* not available, as directed by U. S. EPA.
[3]*Mysidopsis bahia* used in addition to *Penaeus vannami* as described in text. Only one species is required by the permit conditions.

ATTACHMENT I

LABORATORY REPORT
Advanced Biological Testing
96-hour Acute Bioassay

JOINT CANNERY OUTFALL EFFLUENT SAMPLE
March 13-14, 1996

RESULTS OF BIOASSAYS CONDUCTED ON AN EFFLUENT SAMPLE FROM THE JOINT CANNERY OUTFALL IN AMERICAN SAMOA

Using *Penaeus vannami*

Prepared for:

CH2M Hill California, Inc.
1111 Broadway
Oakland, CA 94607
Project # PDX 30702

Prepared by:

Advanced Biological Testing Inc.
98 Main St., # 419
Tiburon, Ca. 94920

April 1, 1996

Ref: 9611

1.0 INTRODUCTION

At the request of CH2M Hill (Project # PDX 30702), Advanced Biological Testing conducted a four day effluent bioassay test on *Penaeus vannami* using effluents collected from the joint cannery outfall at the Starkist and Van Camp tuna canneries in American Samoa. The study was run using methods generally specified in EPA 1991. *Penaeus vannami* is the test species designated in the NPDES permit.

The study was conducted at the Advanced Biological Testing Laboratory in Tiburon, California, and was managed by Mr. Mark Fisler.

2.0 METHODS

2.1 EFFLUENT SAMPLING

The effluents were sampled on March 15, 1996 by cannery personnel under the supervision of CH2M Hill. The sample was received by the laboratory on March 18, 1996. One five gallon carboy was provided, maintained in an ice-filled cooler from the date of sampling until laboratory receipt. The sample was at 5°C upon receipt.

2.2 SAMPLE PREPARATION

The salinity of the effluent sample was 14 ppt. The effluents required salinity adjustment to 30 ppt. The effluent salinity was increased to 30 ppt with 100 ppt natural seawater brine. The brine was made from frozen Bodega Bay seawater. Due to the dilution of the effluent with the brine solution, the initial maximum concentration of effluent was 81%. The highest initial test concentration was made by diluting the 81% effluent with Bodega Bay seawater to an actual effluent concentration of 50%.

The effluents were tested at an actual effluent concentration series of 50%, 25%, 12.5%, 6.25%, and 3.1% as a vol:vol dilutions in seawater. A brine control was run to assess the potential toxicity from the added brine. The diluent and the control water were filtered seawater from Bodega Bay. The dilutions were brought to the test temperature (20 ± 2°C) and aerated continuously. These effluents have been shown to have an increasing biological oxygen demand, with a significant peak at 10-14 hours after test initiation. Previous testing of this effluent without initial aeration has demonstrated significant toxicity at 24 hours (or before); therefore aeration was carried out from the beginning of the test. According to EPA methods the effluents were renewed with effluents held under refrigeration from test initiation on Day 2.

A reference toxicant was run using concentrations provided by the EPA. The toxicant was sodium dodecyl sulfonate (SDS) made up as a 2 grams per liter stock solution in distilled water. The tested concentrations were set at 100, 50, 25, 12.5 and 6.25 mg/L in 30 ppt seawater.

2.3 TESTING PROCEDURES

The bioassay was carried out on post-larval *Penaeus vannami* provided by Brezina and Associates. The animals were air-shipped from Hawaii and were received at ABT on March 19, 1996. Five replicates of each concentration were tested with ten animals per replicate. Water quality was monitored daily as initial quality on Day 0 and final water quality on Days 1-4. Parameters measured included dissolved oxygen, pH, salinity, total ammonia, and temperature.

2.4 STATISTICAL ANALYSIS

At the conclusion of the test, the survival data were evaluated statistically using ToxCalc™ to determine ECp, NOEC, and TU values where appropriate. ToxCalc™ is a comprehensive statistical application that follows standard guidelines for acute and chronic toxicity data analysis. Statistical effects can be measured by the ECp, the estimated concentration that causes any effect, either lethal (LC) or sublethal (IC), on p% of the test population. The LCp is the point estimate of the concentration at which a lethal effect is observed in p% of the test organisms. ECp values include 95% confidence limits if available.

The NOEC (No Observable Effect Concentration) is the highest tested concentration at which mortality and other sublethal measured effects are not significantly different from the same parameters in the control. TU (Toxicity Units) are calculated as 100%/NOEC.

3.0 RESULTS

3.1 INTRODUCTION

Table 1 summarizes the test parameters and conditions. The results of the effluent and reference toxicant bioassays and the water quality monitoring for both sets of tests are presented in Tables 2 through 6.

3.2 TEST RESULTS

Water quality measurements were within the acceptable limits provided in EPA 1991. Temperature was maintained at 20 ± 1°C; pH remained relatively stable, and the salinity increased slightly as would be expected in a static test (Tables 2 and 3). Aeration was maintained in all chambers for the duration of the test. The test solutions were renewed with reserved effluent at 48 hrs (Day 2).

Ammonia was 3.09 ppm in the 50% effluent at test initiation, and increased to 3.21 ppm by Day 4. The LC50 for the effluent was 44.4%. There was significant mortality at the 50% concentrations compared to the control (Table 3). The NOEC was 25%, and the LOEC was 50%. The TU was 4.

The reference toxicant test had an LC50 of 42.9 mg/L (Tables 5 and 6). The laboratory mean was 26.39 mg/L and the data, while higher than the mean, is within two standard deviation of the laboratory mean, indicating normal, though lower sensitivity.

TABLE 1

Bioassay Procedure And Organism Data
For the Survival Bioassay
Using *Penaeus vannami* (*U.S.* EPA 1991)

Parameter	Data
Sample Identification	
Sample ID(s)	960318-1
Date Sampled	3/15/96
Date Received at ABT	3/18/96
Volume Received	Five gallons
Sample Storage Conditions	4°C in the dark
Test Species	*Penaeus vannami*
Supplier	J. Brezina and Associates, Dillon Beach, Ca
Collection location	Hawaii
Date Acquired	3/19/96
Acclimation Time	Used immediately
Acclimation Water	Shipping water
Acclimation Temperature	20±2°C
Age group	Post larvae (approximately 8-10 mm)
Test Procedures	
Type; Duration	Acute, static/renewal at 48 hours
Test Dates	3/19 - 23/96
Control Water	Bodega Bay seawater
Test Temperature	20 ± 2°C
Test Photoperiod	16L : 8 D
Salinity	30± 2 ppt
Test Chamber	1000 mL jars
Animals/Replicate	10
Exposure Volume	500 mL
Replicates/Treatment	5
Feeding	Brine shrimp (24 hr old nauplii)
Deviations from procedures	Aerated continuously

TABLE 2

Penaeus vannami
INITIAL WATER QUALITY MEASUREMENTS
FOR EFFLUENT TEST
Test Dates: 3/19/96 - 3/23/96

Concentration	Day 0					Day 2				
(%)	pH	DO	NH 3	°C	Sal	pH	DO	NH 3	°C	Sal
Control	8.00	7.4	0.01	20.6	29	8.02	8.0	0.02	18.3	30
Brine	8.03	7.4	0.01	20.3	29	8.01	8.0	0.02	18.5	29
3.1	7.91	7.4	0.18	20.4	29	7.84	8.0	0.22	18.6	29
6.25	7.80	7.4	0.37	20.5	29	7.67	7.6	0.42	19.0	29
12.5	7.67	7.4	0.74	20.5	29	7.35	7.4	0.82	18.9	29
25	7.47	7.4	1.51	20.6	29	7.56	8.0	1.62	18.9	29
50	7.54	7.3	3.09	20.6	29	7.33	7.4	3.21	18.6	29
Min	7.47	7.3	0.01	20.3	29	7.33	7.4	0.02	18.3	29
Max	8.03	7.4	3.09	20.6	29	8.02	8.0	3.21	19.0	30

TABLE 3

Penaeus vannami

FINAL WATER QUALITY MEASUREMENTS FOR EFFLUENT TEST

Concentration		Day 1				Day 2				Day 3				Day 4			
(%)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal
Control	1	8.06	7.0	19.1	30	8.05	7.5	19.1	30	8.14	7.6	18.5	30	8.08	7.8	18.0	31
	2	8.06	7.0	18.9	30	8.05	7.4	18.9	30	8.13	7.6	18.3	30	8.09	7.7	18.0	31
	3	8.07	7.1	18.9	30	8.06	7.4	18.9	30	8.13	7.7	18.3	30	8.09	7.8	18.0	31
	4	8.05	7.1	18.9	30	8.03	7.4	18.9	30	8.10	7.7	18.2	30	8.06	7.8	18.0	31
	5	8.08	7.2	18.6	30	8.09	7.6	18.7	30	8.15	7.9	18.0	30	8.12	7.8	18.0	31
Brine	1	8.19	7.2	19.0	30	8.19	7.7	19.0	30	8.29	7.9	18.4	30	8.25	7.8	18.1	31
Control	2	8.17	7.2	18.9	30	8.18	7.6	18.9	30	8.29	7.8	18.2	30	8.23	7.8	18.0	30
	3	8.18	7.2	18.9	30	8.17	7.6	18.9	30	8.29	7.8	18.2	30	8.24	7.8	18.0	30
	4	8.18	7.2	18.9	30	8.17	7.6	18.9	30	8.29	7.8	18.2	30	8.24	7.8	18.0	30
	5	8.19	7.3	18.9	30	8.19	7.6	18.9	30	8.30	8.0	18.2	30	8.25	7.8	18.0	30
3.1	1	8.02	7.2	19.1	30	8.07	7.7	19.1	30	8.15	7.9	18.4	30	8.14	8.0	18.0	30
	2	8.05	7.2	18.9	30	8.11	7.6	18.9	30	8.18	8.0	18.2	30	8.15	7.9	18.1	30
	3	8.04	7.2	18.9	30	8.10	7.6	18.9	30	8.16	7.8	18.2	30	8.14	7.9	18.0	30
	4	8.02	7.2	18.9	30	8.08	7.6	18.9	30	8.15	7.8	18.3	30	8.13	7.9	18.0	30
	5	8.06	7.2	18.9	30	8.12	7.6	18.9	30	8.18	7.8	18.3	30	8.16	7.9	18.0	30
6.25	1	8.02	7.2	19.0	30	8.10	7.7	19.1	30	8.16	7.9	18.5	30	8.16	8.0	18.0	30
	2	8.01	7.2	18.9	30	8.11	7.6	19.0	30	8.17	7.9	18.4	30	8.16	7.9	18.0	30
	3	7.99	7.1	18.9	30	8.11	7.6	18.9	30	8.17	7.8	18.3	30	8.18	7.9	18.1	30
	4	7.96	7.0	18.9	30	8.08	7.6	19.0	30	8.12	7.8	18.4	30	8.15	7.8	18.0	30
	5	7.89	6.8	18.9	30	8.04	7.6	18.9	30	8.06	7.8	18.4	30	8.11	7.8	18.1	30
12.5	1	7.96	7.0	19.1	30	8.09	7.6	19.1	30	8.14	7.8	18.6	30	8.19	8.0	18.0	30
	2	7.98	7.0	19.0	30	8.12	7.6	19.1	30	7.82	6.9	18.6	30	7.97	7.6	18.1	30
	3	7.90	6.9	19.0	30	8.03	7.6	19.1	30	7.96	7.4	18.5	30	8.08	7.6	18.0	30
	4	7.98	7.0	19.0	30	8.10	7.6	19.1	30	8.11	7.6	18.5	30	8.19	7.8	18.0	30
	5	8.03	7.0	19.0	30	8.14	7.6	18.9	30	8.18	7.7	18.3	30	8.22	7.8	18.0	30
25	1	8.02	7.0	19.2	30	8.12	7.6	19.2	30	8.20	7.8	18.6	30	8.25	7.9	18.2	31
	2	8.06	6.9	19.1	30	8.14	7.4	19.1	30	8.20	7.6	18.5	30	8.26	7.8	18.1	31
	3	8.11	7.0	18.9	30	8.19	7.5	19.1	30	8.24	7.6	18.4	30	8.28	7.8	18.0	31
	4	8.06	7.0	18.9	30	8.15	7.4	19.1	30	8.21	7.7	18.4	30	8.26	7.8	18.0	31
	5	8.11	7.0	18.9	30	8.18	7.4	19.0	30	8.25	7.4	18.4	30	8.28	7.8	18.0	31
50	1	8.01	6.8	18.9	30	8.16	7.2	18.9	30	8.19	7.4	18.4	30	8.31	7.8	18.0	31
	2	8.07	6.8	18.9	30	8.24	7.4	18.9	30	8.27	7.4	18.3	30	8.37	7.6	18.1	31
	3	8.10	6.8	18.9	30	8.23	7.4	18.9	30	8.25	7.6	18.3	30	8.37	7.6	18.0	31
	4	8.13	7.0	18.7	30	8.29	7.6	18.8	30	8.28	7.6	18.2	30	8.39	7.7	18.1	31
	5	8.11	6.8	18.9	30	8.27	7.6	18.9	30	8.26	7.6	18.4	30	8.39	7.8	18.0	31
Min		7.89	6.8	18.6	30	8.03	7.2	18.7	30	7.82	6.9	18.0	30	7.97	7.6	18.0	30
Max		8.19	7.3	19.2	30	8.29	7.7	19.2	30	8.30	8.0	18.6	30	8.39	8.0	18.2	31

TABLE 4

Penaeus vannami
SURVIVAL DATA FOR EFFLUENT TEST

Concentration (%)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
Brine Control	1	10	8	8	8	8	80	
	2	10	10	10	10	9	90	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	94.0
3.1	1	12	12	12	12	12	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
6.25	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
12.5	1	10	10	10	10	10	100	
	2	10	10	10	7	4	40	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	88.0
25	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
50	1	10	10	10	10	1	10	
	2	10	10	10	10	2	20	
	3	10	10	10	10	7	70	
	4	10	10	10	10	4	40	
	5	10	10	10	10	4	40	36.0

TABLE 5

Penaeus vannami
WATER QUALITY MEASUREMENTS
FOR REFERENCE TOXICANT (S.D.S) TEST

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(mg/L)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal
Control	1	8.00	7.4	20.4	29	7.88	6.0	19.2	30	7.70	5.6	19.3	30	7.63	5.4	18.7	30	7.66	6.2	18.3	30
	2					7.91	6.0	19.1	30	7.79	6.0	19.1	30	7.80	6.2	18.5	30	7.77	6.6	18.0	30
	3					7.91	6.0	19.1	30	7.80	6.2	19.1	30	7.81	6.3	18.5	30	7.78	6.8	18.0	30
6.25	1	8.02	7.4	20.4	29	7.78	4.6	19.2	30	7.62	5.2	19.2	30	7.72	6.2	18.6	30	7.72	6.6	18.1	31
	2					7.70	4.5	19.2	30	7.57	5.2	19.1	30	7.68	6.0	18.5	30	7.69	6.4	18.0	31
	3					7.72	4.5	19.2	30	7.58	5.2	19.2	30	7.69	6.0	18.6	30	7.70	6.4	18.1	31
12.5	1	8.03	7.5	20.4	29	7.71	4.5	19.2	30	7.50	4.4	19.2	30	7.66	5.8	18.6	30	7.67	6.4	18.0	31
	2					7.72	4.5	19.2	30	7.41	4.0	19.2	30	7.59	5.8	18.6	30	7.60	6.0	18.0	31
	3					7.77	4.4	19.3	30	7.38	3.9	19.2	30	7.56	5.6	18.6	30	7.58	6.0	18.2	31
25	1	8.03	7.5	20.3	29	7.80	4.6	19.3	30	7.37	2.7	19.2	30	7.47	4.5	18.7	30	7.51	5.6	18.2	30
	2					7.70	4.4	19.2	30	7.31	2.0	19.2	30	7.47	4.6	18.6	30	7.57	5.7	18.0	31
	3					7.74	4.4	19.3	30	7.32	2.2	19.3	30	7.43	4.4	18.7	30	7.50	5.6	18.3	31
50	1	8.04	7.6	20.4	29	7.75	4.5	19.3	30	7.28	2.0	19.3	30	7.25	2.2	18.9	30	7.31	3.8	18.4	31
	2					7.77	4.8	19.2	30	7.26	2.0	19.2	30	7.21	1.6	18.9	30	7.18	2.2	18.3	31
	3					7.80	4.8	19.4	30	7.27	2.0	19.4	30	7.22	1.8	18.9	30	7.18	2.4	18.5	31
100	1	8.04	7.6	20.4	29	7.87	5.1	19.4	30	—	—	—	—	—	—	—	—	—	—	—	—
	2					7.79	4.4	19.3	30	—	—	—	—	—	—	—	—	—	—	—	—
	3					7.82	4.7	19.4	30	7.17	0.4	19.4	30	—	—	—	—	—	—	—	—
Min		8.00	7.4	20.3	29	7.70	4.4	19.1	30	7.17	0.4	19.1	30	7.21	1.6	18.5	30	7.18	2.2	18.0	30
Max		8.04	7.6	20.4	29	7.91	6.0	19.4	30	7.80	6.2	19.4	30	7.81	6.3	18.9	30	7.78	6.8	18.5	31

Note: — = All animals dead.

TABLE 6

Penaeus vannami
SURVIVAL DATA FOR REFERENCE TOXICANT (S.D.S.) TEST

Concentration (mg/L)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	**1**	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	100.0
6.25	**1**	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	100.0
12.5	**1**	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	100.0
25	**1**	10	10	9	10	10	100	
	2	10	10	8	10	10	100	
	3	10	10	10	10	10	100	100.0
50	**1**	10	9	9	3	3	30	
	2	10	10	10	8	6	60	
	3	10	10	10	3	0	0	30.0
100	**1**	10	0	—	—	—	0	
	2	10	0	—	—	—	0	
	3	10	1	0	—	—	0	0.0

Note: — = All animals dead.

LC50 = 42.9 mg/L.
Laboratory mean = 26.39 mg/L.

4.0
REFERENCES

U.S. EPA. 1991. Methods for measuring acute toxicity of effluents to freshwater and marine organisms, 4th ed. EPA 600/4-90/027, September, 1991.

Rcd 9/9/96.
Cpy to Mike

Engineers
Planners
Economists
Scientists

6 September 1996

107091.EL.96 (OPE30702)

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa
Environmental Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat and Sheila:

Subject: **StarKist Samoa Effluent Chemistry Testing**
Delayed October 1995 Tests
NPDES Permit No. AS0000019

Enclosed are two copies of a Technical Memorandum describing the results of the sixth priority pollutant analyses done under StarKist Samoa's NPDES permit requirements. This report covers the effluent sampling done in February 1996 which, as you know, was delayed for reasons explained in the report. I am forwarding the results of the VCS Samoa Packing analyses under separate cover. The results of the concurrent bioassay tests were mailed on 9 August 1996. The March 1996 sample test results will be mailed within a week. The next tests are scheduled for October 1996.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: Norman Wei, StarKist Seafood Company (with 1 copy of enclosure)
Barry Mills, StarKist Samoa, Inc. (with 1 copy of enclosure)

Rcd 9/9/96

CH2M HILL

TECHNICAL MEMORANDUM

PREPARED FOR: StarKist Samoa, Inc. (NPDES Permit AS0000019)

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen Glatzel/Glatzel & Associates

DATE: 29 August 1996

SUBJECT: **Chemical Analysis of Effluent: February 1996 (Delayed Sept/Oct 1995) Sampling**

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the chemical analyses of StarKist Samoa effluent samples that were collected in February 1996. The effluent sampling conducted during February 1996 was delayed from the originally scheduled Sept/Oct 1995 sampling.

The sampling and testing initially planned for October 1995 was delayed as a result of problems encountered in shipping laboratory sample containers for the required effluent chemistry tests. International Air Transportation Association (IATA) regulations for the shipment of dangerous goods were revised in the Fall of 1995. The nitric acid preservative used in the metals chemistry bottles falls under these regulations, but an exception based on volume should have applied. The new regulations were confusing for all air cargo shippers using commercial carriers and shipments were refused by the commercial air carrier from Honolulu to American Samoa.

Multiple shipments of sample bottles were attempted using Federal Express, DHL, and Airborne Express. Alternative shipping using private air cargo transport or container ships was subject to further delays because of the schedules of the available shippers between December 1995 and late January 1996. Sample containers were successfully shipped via Triple B Packers at the end of January (the Airborne Express shipment did finally arrive later via New Zealand, but Federal Express and DHL were never successful in transporting shipments using Hawaiian Airlines from Honolulu).

StarKist Samoa collected the samples within one week of the arrival of the sample containers. No problems in returning samples to the mainland United States are encountered because the preservative is diluted to the point where it is no longer considered dangerous goods. Attempts to avoid future delays will be made by early shipping and stockpiling sample collection kits in Samoa in advance of the tests. Although the canneries have little storage space available, an attempt will be made to secure an area for sample container storage in the future.

Study Objectives

Section D.2 of StarKist Samoa's NPDES permit (AS0000019) requires that semiannual priority pollutant analyses be conducted on the cannery effluent concurrently with bioassay tests. Each effluent sampling event must coincide with effluent sampling for acute biomonitoring. Effluent samples are collected as composite samples as described below. The purpose of these analyses is to identify the chemicals present in the effluent, and provide data to determine whether the wastewater discharge complies with ambient water quality standards.

Effluent priority pollutant analyses include those chemical constituents listed in 40 CFR 401.15. As documented in the Technical Memorandum describing the results of the March 1995 sampling (CH2M HILL, 20 June 1995) the U.S. EPA Region 9 has allowed StarKist Samoa to exclude a number of previously measured constituents in the priority pollutant list. The constituents currently included in the effluent chemistry analyses are listed in Table 1.

Methods

Between 1200 on 01 February and 0900 on 02 February 1996, a 24-hour, flow-weighted composite sample of final effluent was collected from the StarKist Samoa treatment plant discharge. Effluent composite samples were collected simultaneously for chemistry and bioassay analyses. Table 1 lists the chemical analyses, detection limits, sample holding times, sample containers, and sample preservations for these effluent samples. The standard operating procedures (SOP) for the joint cannery outfall chemistry sampling is provided in the Technical Memorandum describing the bioassay tests conducted with the March 1995 effluent sample (CH2M HILL, 20 June 1995).

Samples were collected from the established effluent sampling site following the routine composite sample collection schedule for the plant. A total of eight individual grab samples were collected into pre-cleaned glass containers at approximately three-hour intervals over a 24 hour period. The samples were stored on ice until the completion of the 24-hour sampling period, and then a flow-weighted composite sample was prepared. The grab sample collection times and the calculated individual volumes of each grab sample used to create the composite sample, based on StarKist Samoa's flow records, are summarized in Table 2. The final composite sample was used to fill the sample containers sent to the laboratory for analyses.

Sample containers were wrapped in bubble-wrap, placed in zip-lock bags, and packed on ice for shipment to the laboratory. Sample chain of custody forms were completed, sealed into zip-lock bags, and taped inside the lid of the ice chest. Samples were shipped DHL on flights from Pago Pago to Honolulu and then to San Francisco. Samples that were composited on 03 February, were delivered to GTEL Environmental Laboratories, Inc. on 06 February 1996.

Results

Complete laboratory data sets, laboratory quality control data reports, and chain-of-custody forms are attached to this memorandum. The chain-of-custody form is included as Attachment I and analytical data sheets and quality control data reports are included as Attachment II. Table 1 indicates the method detection limits requested from the analytical laboratory along with those achieved during the analysis. The laboratory indicated prior to sample analysis that the requested detection limits could be achieved. Requested detection limits were achieved for the semivolatiles, total phenols, lead, silver, and zinc only. Discussions with the laboratory staff will be conducted to address the problems associated with those detection limits achieved. If the problems cannot be resolved, an alternate laboratory that can achieve the requested detection limits will be sought.

As shown in the chain-of-custody form (Attachment I) the laboratory was supposed to measure pH in the metals samples to verify the correct acidification. The laboratory reported a pH in the unpreserved semivolatile sample, which was not requested and not needed. This problem will be corrected in the future.

The analyses conducted detected few chemical parameters in effluent from StarKist Samoa. A total of 2 inorganics were detected (copper and zinc) and 3 semivolatile organics were detected: (phenol, 4-methylphenol, and total recoverable phenols). Table 3 summarizes the sample results for the substances detected for the February 1996 effluent sample analysis compared to those detected during previous analyses.

Table 1
Effluent Sample Analyses and Handling Procedures
at StarKist Samoa, 01-02 February 1996

Chemical Parameter	Analytical Method	Detection Limits, µg/l		Sample Holding Time	Sample Container	Sample Preservation
		Requested	Achieved			
Semivolatile Organics	EPA 625 and 8270	10-50	10-50	7 days	1 liter amber glass	4 degrees C
Phenols	EPA 420.1	13	5		500 ml plastic	5 ml H_2SO_4
Inorganics[1]						
Arsenic	EPA 206.2	5	10[2]	6 months	500 ml plastic	5 ml 2N HNO_3
Cadmium	EPA 200.7	5	20	"	"	"
Chromium	EPA 200.7	10	30	"	"	"
Copper	EPA 220.2	2	5	"	"	"
Lead	EPA 239.2	5	4	"	"	"
Mercury	EPA 245.1	0.4	1.0	"	"	"
Selenium	EPA 270.1	5	200[2]	"	"	"
Silver	EPA 272.2	2	2	"	"	"
Zinc	EPA 200.7	20	20	"	"	"

[1] All Inorganics were from one 500 ml plastic sample container, using 5ml 2N HNO_3 preservative.

[2] Detection limit raised from 5 µg/l due to matrix interference.

Table 2
Effluent Chemistry 24-hour Composite Sample Collection at StarKist Samoa, 01-02 February 1996

Grab Sample Number	Sampling Time	Sampling Date	Effluent Flow Rate (mgd)[1]	Percent of Total Flow	Volume of Sample (ml)	
					1 liter	500 ml
1	1200	2/1/96	1.19	11.4	114	57.0
2	1500	2/1/96	1.33	12.8	128	64.0
3	1800	2/1/96	1.75	16.8	168	84.0
4	2100	2/1/96	0.84	8.1	81	40.5
5	2400	2/1/96	1.05	10.1	101	50.5
6	0300	2/2/96	1.30	12.5	125	62.5
7	0600	2/2/96	1.68	16.2	162	81.0
8	0900	2/2/96	1.26	12.1	121	60.5
TOTALS			10.40	100.0	1000	500

[1] Mean Effluent Flow Rate = 1.30 mgd.

Table 3
Summary of StarKist Samoa Effluent Chemistry Sample Results
01 - 02 February 1996

Substance	Previous Sample Results, µg/L (ppb)					February 1996 Sample Results, µg/L (ppb)
	February 1993	October 1993[1]	February 1994	October 1994	March 1995	
Inorganics						
Arsenic	6.0	ND (14)	ND	9	ND[2]	ND
Cadmium	ND	ND	10	ND	ND	ND
Copper	ND	(ND)	15	ND	6	13
Selenium	ND	ND	ND[3]	ND[3]	ND[3]	ND[4]
Silver	130	33 (39)	ND	ND	ND	ND
Zinc	92	130 (180)	140	84	120	63
Semivolatile Organics						
Phenol	500	430	45	140	32	32
4-Methylphenol	260	530	360	290	310	130
Total Recoverable Phenols	NA	1300	120	15	34	72

ND = Not Detected
NA = Not Analyzed
[1] Values in parentheses are results of reanalyzed samples (see Technical Memorandum for October 1993 sampling episode).
[2] Detection limit raised to 50 µg/l due to matrix interference.
[3] Detection limit raised to 50 µg/l due to matrix interference, with the resultant concentration <50 µg/l each time.
[4] Detection limit raised to 200 µg/l due to matrix interference, with the resultant concentration <200 µg/l.

ATTACHMENT I

CHAIN OF CUSTODY FORM

STARKIST SAMOA, INC. EFFLUENT SAMPLE
01 - 02 February 1996

CH2M HILL

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project # 107091 ELT6

Purchase Order #

Project Name: Star Kist Samoa Effluent

Company Name/CH2M HILL Office: CH2M HILL / SFO

Project Manager & Phone #: Mr. [ ] Steve Costa; Ms. [ ]; Dr. [X] 510-251-2426(225) CH2M HILL/SFO

Report Copy to: Steve Costa

Requested Completion Date:

Sampling Requirements: SDWA [ ] NPDES [X] RCRA [ ] OTHER ____

Sample Disposal: Dispose [ ] Return [ ] See Below

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	Total Phenols EPA 420.1	SEMI - Volatiles EPA - 625	pH	ARSENIC EPA 206.2	CADMIUM EPA 200.7	CHROMIUM EPA 200.7	COPPER EPA 220.2	LEAD EPA 239.2	MERCURY EPA 245.1	SELENIUM EPA 270.2	SILVER EPA 272.2	ZINC EPA 200.7	LAB 1 ID	LAB 2 ID
2/2		X		X			SSKSV	1		X											01	
2/2		X		X			SSKPH	1	X												02	
2/2		X		X			SSKM	2			X	X	X	X	XX	X	XX	X		X	03&04	
2/2		X		X																	05	
																					06	
																					07	
																					08	
																					09	
																					10	

LAB TEST CODES

SHADED AREA-- FOR LAB USE ONLY

Lab 1 # | Lab 2 #

Quote # | Kit Request #

Project #

No. of Samples | Page 1 of 1

Login | LIMS Ver

REMARKS

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Lesina KAMILO	02/2/96		
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time 2.6.96	Shipped Via UPS BUS Fed-Ex Hand Other DHL	Shipping #
Work Authorized By (Please sign and print name)	Remarks 10° - Seal absent		

QC Level: 1 2 3 Other: ____

COC Rec	ICE
Ana Req	TEMP
Cust Seal	Ph

Instructions and Agreement Provisions on Reverse Side

DHL # 7960562772

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340

ATTACHMENT II

LABORATORY DATA REPORT
GTEL Environmental Laboratories, Inc.

STARKIST SAMOA, INC. EFFLUENT SAMPLE
01 - 02 February 1996

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

March 11, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Dear Steve Costa:

This report, previously dated 02/26/96, is a reissue.

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 02/06/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020102-01	--	--	--
Client ID	SKSV	--	--	--
Date Sampled	02/02/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/10/96	--	--	--
Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
N-Nitrosodimethylamine	10.	ug/L	< 10.	--	--	--
Aniline	10.	ug/L	< 10.	--	--	--
Phenol	10.	ug/L	**32.**	--	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 10.	--	--	--
2-Chlorophenol	10.	ug/L	< 10.	--	--	--
1,3-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
1,4-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
Benzyl Alcohol	10.	ug/L	< 10.	--	--	--
1,2-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
2-Methylphenol	10.	ug/L	< 10.	--	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 10.	--	--	--
4-Methylphenol	10.	ug/L	**130**	--	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 10.	--	--	--
Hexachloroethane	10.	ug/L	< 10.	--	--	--
Nitrobenzene	10.	ug/L	< 10.	--	--	--
Isophorone	10.	ug/L	< 10.	--	--	--
2-Nitrophenol	10.	ug/L	< 10.	--	--	--
2,4-Dimethylphenol	10.	ug/L	< 10.	--	--	--
Benzoic Acid	50.	ug/L	< 50.	--	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 10.	--	--	--
2,4-Dichlorophenol	10.	ug/L	< 10.	--	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 10.	--	--	--
Naphthalene	10.	ug/L	< 10.	--	--	--
4-Chloroaniline	50.	ug/L	< 50.	--	--	--
Hexachlorobutadiene	10.	ug/L	< 10.	--	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 20.	--	--	--
2-Methylnaphthalene	10.	ug/L	< 10.	--	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 10.	--	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 10.	--	--	--
2,4,5-Trichlorophenol	10.	ug/L	< 10.	--	--	--
2-Chloronaphthalene	10.	ug/L	< 10.	--	--	--
2-Nitroaniline	50.	ug/L	< 50.	--	--	--
Dimethyl phthalate	10.	ug/L	< 10.	--	--	--
Acenaphthylene	10.	ug/L	< 10.	--	--	--
2,6-Dinitrotoluene	10.	ug/L	< 10.	--	--	--
3-Nitroaniline	10.	ug/L	< 10.	--	--	--
Acenaphthene	10.	ug/L	< 10.	--	--	--
2,4-Dinitrophenol	50.	ug/L	< 50.	--	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020102-01	--	--	--
Client ID	SKSV	--	--	--
Date Sampled	02/02/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/10/96	--	--	--
Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
4-Nitrophenol	50.	ug/L	< 50.	--	--	--
Dibenzofuran	10.	ug/L	< 10.	--	--	--
2,4-Dinitrotoluene	10.	ug/L	< 10.	--	--	--
Diethyl phthalate	10.	ug/L	< 10.	--	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 10.	--	--	--
Fluorene	10.	ug/L	< 10.	--	--	--
4-Nitroaniline	50.	ug/L	< 50.	--	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 50.	--	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 10.	--	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 50.	--	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 10.	--	--	--
Hexachlorobenzene	10.	ug/L	< 10.	--	--	--
Pentachlorophenol	50.	ug/L	< 50.	--	--	--
Phenanthrene	10.	ug/L	< 10.	--	--	--
Anthracene	10.	ug/L	< 10.	--	--	--
Carbazole	10.	ug/L	< 10.	--	--	--
Di-n-butyl phthalate	10.	ug/L	< 10.	--	--	--
Fluoranthene	10.	ug/L	< 10.	--	--	--
Benzidine	50.	ug/L	< 50.	--	--	--
Pyrene	10.	ug/L	< 10.	--	--	--
Butyl benzyl phthalate	10.	ug/L	< 10.	--	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 20.	--	--	--
Benzo(a)anthracene	10.	ug/L	< 10.	--	--	--
Chrysene	10.	ug/L	< 10.	--	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 10.	--	--	--
Di-n-octyl phthalate	10.	ug/L	< 10.	--	--	--
Benzo(b)fluoranthene	10.	ug/L	< 10.	--	--	--
Benzo(k)fluoranthene	10.	ug/L	< 10.	--	--	--
Benzo(a)pyrene	10.	ug/L	< 10.	--	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 10.	--	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 10.	--	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 10.	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants". Code of Federal Regulations, 40CFR Part 136, Appendix A. 1,2-Diphenylhydrazine is quantified as

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020102-01	--	--	--
Client ID	SKSV	--	--	--
Date Sampled	02/02/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/10/96	--	--	--
Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:

Notes: (continued)

azobenzene. Sample preparation by liquid/liquid extraction.

W6020102-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogates being outside of acceptability limits due to matrix effects.

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

February 26, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Dear Steve Costa:

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 02/06/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Project Coordinator

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020102-01	--	--	--
Client ID	SKSV	--	--	--
Date Sampled	02/02/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/10/96	--	--	--
Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
N-Nitrosodimethylamine	10.	ug/L	< 10.	--	--	--
Phenol	10.	ug/L	**32.**	--	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 10.	--	--	--
2-Chlorophenol	10.	ug/L	< 10.	--	--	--
1,3-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
1,4-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
1,2-Dichlorobenzene	10.	ug/L	< 10.	--	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 10.	--	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 10.	--	--	--
Hexachloroethane	10.	ug/L	< 10.	--	--	--
Nitrobenzene	10.	ug/L	< 10.	--	--	--
Isophorone	10.	ug/L	< 10.	--	--	--
2-Nitrophenol	10.	ug/L	< 10.	--	--	--
2,4-Dimethylphenol	10.	ug/L	< 10.	--	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 10.	--	--	--
2,4-Dichlorophenol	10.	ug/L	< 10.	--	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 10.	--	--	--
Naphthalene	10.	ug/L	< 10.	--	--	--
Hexachlorobutadiene	10.	ug/L	< 10.	--	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 20.	--	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 10.	--	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 10.	--	--	--
2-Chloronaphthalene	10.	ug/L	< 10.	--	--	--
Dimethyl phthalate	10.	ug/L	< 10.	--	--	--
Acenaphthylene	10.	ug/L	< 10.	--	--	--
2,6-Dinitrotoluene	10.	ug/L	< 10.	--	--	--
Acenaphthene	10.	ug/L	< 10.	--	--	--
2,4-Dinitrophenol	50.	ug/L	< 50.	--	--	--
4-Nitrophenol	50.	ug/L	< 50.	--	--	--
2,4-Dinitrotoluene	10.	ug/L	< 10.	--	--	--
Diethyl phthalate	10.	ug/L	< 10.	--	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 10.	--	--	--
Fluorene	10.	ug/L	< 10.	--	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 50.	--	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 10.	--	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 50.	--	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 10.	--	--	--
Hexachlorobenzene	10.	ug/L	< 10.	--	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020102-01	--	--	--
Client ID	SKSV	--	--	--
Date Sampled	02/02/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/10/96	--	--	--
Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
Pentachlorophenol	50.	ug/L	< 50.	--	--	--
Phenanthrene	10.	ug/L	< 10.	--	--	--
Anthracene	10.	ug/L	< 10.	--	--	--
Di-n-butyl phthalate	10.	ug/L	< 10.	--	--	--
Fluoranthene	10.	ug/L	< 10.	--	--	--
Benzidine	50.	ug/L	< 50.	--	--	--
Pyrene	10.	ug/L	< 10.	--	--	--
Butyl benzyl phthalate	10.	ug/L	< 10.	--	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 20.	--	--	--
Benzo(a)anthracene	10.	ug/L	< 10.	--	--	--
Chrysene	10.	ug/L	< 10.	--	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 10.	--	--	--
Di-n-octyl phthalate	10.	ug/L	< 10.	--	--	--
Benzo(b)fluoranthene	10.	ug/L	< 10.	--	--	--
Benzo(k)fluoranthene	10.	ug/L	< 10.	--	--	--
Benzo(a)pyrene	10.	ug/L	< 10.	--	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 10.	--	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 10.	--	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 10.	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants", Code of Federal Regulations, 40CFR Part 136, Appendix A. 1,2-Diphenylhydrazine is quantified as azobenzene. Sample preparation by liquid/liquid extraction.

W6020102-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogates being outside of acceptability limits due to matrix effects.

ANALYTICAL RESULTS
Results For Multiple Methods

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Method: See Below
Matrix: Aqueous

	GTEL Sample Number	W6020102-03	--	--	--
	Client ID	SKM	--	--	--
	Date Sampled	02/02/96	--	--	--
EPA 200.7	Date Prepared	02/07/96	--	--	--
EPA 200.7	Date Analyzed	02/08/96	--	--	--
EPA 200.7	Dilution Factor	1.00	--	--	--
EPA 206.2	Date Prepared	02/09/96	--	--	--
EPA 206.2	Date Analyzed	02/09/96	--	--	--
EPA 206.2	Dilution Factor	1.00	--	--	--
EPA 220.2	Date Prepared	02/08/96	--	--	--
EPA 220.2	Date Analyzed	02/12/96	--	--	--
EPA 220.2	Dilution Factor	1.00	--	--	--
EPA 239.2	Date Prepared	02/08/96	--	--	--
EPA 239.2	Date Analyzed	02/08/96	--	--	--
EPA 239.2	Dilution Factor	1.00	--	--	--
EPA 245.1	Date Prepared	02/08/96	--	--	--
EPA 245.1	Date Analyzed	02/08/96	--	--	--
EPA 245.1	Dilution Factor	2.00	--	--	--
EPA 270.2	Date Prepared	02/09/96	--	--	--
EPA 270.2	Date Analyzed	02/13/96	--	--	--
EPA 270.2	Dilution Factor	20.0	--	--	--
EPA 272.2	Date Prepared	02/08/96	--	--	--
EPA 272.2	Date Analyzed	02/14/96	--	--	--
EPA 272.2	Dilution Factor	1.00	--	--	--

Analyte		Reporting Limit	Units	Concentration:			
Inorganics (MT, WC)							
Arsenic	EPA 206.2	10.	ug/L	< 10.	--	--	--
Cadmium	EPA 200.7	20.	ug/L	< 20.	--	--	--
Chromium	EPA 200.7	30.	ug/L	< 30.	--	--	--
Copper	EPA 220.2	5.0	ug/L	**13.**	--	--	--
Lead	EPA 239.2	4.0	ug/L	< 4.0	--	--	--
Mercury	EPA 245.1	0.50	ug/L	< 1.0	--	--	--
Selenium	EPA 270.2	10.	ug/L	< 200	--	--	--
Silver	EPA 272.2	2.0	ug/L	< 2.0	--	--	--
Zinc	EPA 200.7	20.	ug/L	**63.**	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 200.7, EPA 206.2, EPA 220.2, EPA 239.2, EPA 245.1, EPA 270.2:

Digestion is method specific.

EPA 200.7, EPA 206.2, EPA 239.2, EPA 245.1, EPA 270.2, EPA 272.2:

"Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, USEPA EMSL, Cincinnati, OH, Revised, March 1983.

W6020102-03:

GTEL Wichita, KS

ANALYTICAL RESULTS
Results For Multiple Methods

GTEL Client ID: CHH02CHH02
Login Number: W6020102
Project ID (number): 107091ELT6
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Method: See Below
Matrix: Aqueous

	GTEL Sample Number	W6020102-03	--	--	--
	Client ID	SKM	--	--	--
	Date Sampled	02/02/96	--	--	--
EPA 200.7	Date Prepared	02/07/96	--	--	--
EPA 200.7	Date Analyzed	02/08/96	--	--	--
EPA 200.7	Dilution Factor	1.00	--	--	--
EPA 206.2	Date Prepared	02/09/96	--	--	--
EPA 206.2	Date Analyzed	02/09/96	--	--	--
EPA 206.2	Dilution Factor	1.00	--	--	--
EPA 220.2	Date Prepared	02/08/96	--	--	--
EPA 220.2	Date Analyzed	02/12/96	--	--	--
EPA 220.2	Dilution Factor	1.00	--	--	--
EPA 239.2	Date Prepared	02/08/96	--	--	--
EPA 239.2	Date Analyzed	02/08/96	--	--	--
EPA 239.2	Dilution Factor	1.00	--	--	--
EPA 245.1	Date Prepared	02/08/96	--	--	--
EPA 245.1	Date Analyzed	02/08/96	--	--	--
EPA 245.1	Dilution Factor	2.00	--	--	--
EPA 270.2	Date Prepared	02/09/96	--	--	--
EPA 270.2	Date Analyzed	02/13/96	--	--	--
EPA 270.2	Dilution Factor	20.0	--	--	--
EPA 272.2	Date Prepared	02/08/96	--	--	--
EPA 272.2	Date Analyzed	02/14/96	--	--	--
EPA 272.2	Dilution Factor	1.00	--	--	--

Analyte	Reporting Limit	Units	Concentration:

Notes: (continued)

Recovery limits were exceeded for arsenic and selenium in the matrix spike and/or matrix spike duplicate sample due to matrix interference as proven by analytical spike. Recovery limits were exceeded for silver in the matrix spike and/or matrix spike duplicate sample in this analytical batch due to matrix interference as implied by analytical spike.

GTEL Client ID: CHH02.CHH02
Project ID (Number): 107091ELT6
Project ID (Name): Star Kist Samoa
Effluent
Pago Pago, AS
Work Order Number: W6-02-0102
Date Reported: 02-21-96

ANALYTICAL RESULTS

Inorganics in Water

GTEL Sample Number			01	02		
Client Identification			SKSV	SKPH		
Date Sampled			02-02-96	02-02-96		
Date Analyzed			02-07-96	02-20-96		
Analyte	Method	QL *& Units	Concentration			
pH	EPA 150.1	NA	**6.5**	---		
Total Recoverable Phenols	EPA 420.1	0.005 mg/L	---	**0.072**		

* Quantitation Limit

NA Not applicable

Copy to Vance Fong/Eugenia for review

CH2M HILL
Engineers
Planners
Economists
Scientists

9 August 1996

107091.EL.96

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa
Environmental Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat and Shiela:

Subject: **Joint Cannery Outfall Effluent Bioassay Testing**
Results of Bioassay Tests 6 (Feb 96) and 7 (Mar 96)

Enclosed are two copies each of technical memoranda describing the results of the sixth and seventh episodes of whole effluent bioassay testing done under StarKist Samoa and VCS Samoa Packing NPDES permit requirements. As you know the test scheduled for October 1995 was delayed until early February 1996 because of shipping problems as described in the memorandum. For the tests done on the February 1996 samples, we performed bioassays on both *Penaeus vannami* and *Mysidopsis bahia* for reasons described in the report. For the March 1996 sample, we used only a single species, *Penaeus vannami*. This is the species we will use in the future, unless availability requires us to substitue *Mysidopis bahia*. Unless USEPA or ASEPA have specific concerns, we will continue performing the tests as described in these reports. I have not sent copies directly to anyone else at USEPA since I am not sure who you will want to further review the reports (I have included an extra copy for USEPA to forward as appropriate). The next test is scheduled for September/October 1996.

If you have any questions please feel free to call me at your convenience.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

AUG 13 1996
RECEIVED

cc: USEPA Region IX, (1 extra copy of enclosure for distribution)
Norman Wei, StarKist Seafood Company (1 copy of enclosure)
James Cox, Van Camp Seafood Company (1 copy of enclosures)
Barry Mills, StarKist Samoa, Inc. (1 copy of enclosures)
Bill Perez, VCS Samoa Packing Company (1 copy of enclosures)
Kurt Kline, Advanced Biological Testing (1 copy of enclosure)
Karen Glatzel, Glatzel and Associates

TECHNICAL MEMORANDUM

CH2M HILL

PREPARED FOR: StarKist Samoa, Inc.
VCS Samoa Packing Company, Inc.

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen A. Glatzel/Glatzel & Associates

DATE: 9 August 1996

SUBJECT: **Bioassay Testing of Effluent**
February 1996 (Delayed Fall Sept/Oct 1995) Sampling

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the effluent bioassay testing of the Joint Cannery Outfall effluent sample that was collected in February 1996. This is the sixth of the required semi-annual tests. Separate technical memoranda describe the results of concurrent effluent chemistry testing. The February 1996 bioassay test is considered to replace the delayed Fall (Sept/Oct) 1995 test.

The test initially planned for October 1995 was delayed as a result of problems encountered in shipping laboratory sample containers for the required concurrent effluent chemistry tests. International Air Transportation Association (IATA) regulations for the shipment of dangerous goods were revised in the Fall of 1995. The nitric acid preservative used in the metals chemistry bottles falls under these regulations, but an exception based on volume should have applied. The new regulations were confusing for all air cargo shippers using commercial carriers and shipments were refused by the commercial air carrier from Honolulu to American Samoa. Multiple shipments of sample bottles were attempted using FEDEX, DHL, and AIRBORNE EXPRESS.

Alternative shipping through a private air cargo and container ship was delayed because of schedule delays between December 1995 and late January 1996 of these transporters. Sample containers were shipped via Triple B Packers at the end of January. The canneries collected the samples within one week of the arrival of the sample containers. Attempts to avoid future delays will be made by early shipping and stockpiling sample collection kits in Samoa in advance of the tests. Although the canneries have little storage space available, an attempt will be made to secure an area for sample containers in the future.

Study Objectives

Section D.1 of the StarKist Samoa and VCS Samoa Packing NPDES permits requires that semi-annual definitive acute bioassays (96-hour static bioassays) be conducted on the

cannery effluent. The purpose of these bioassays is to determine whether, and at what effluent concentration, acute toxicity may be detected for the effluent.

U.S. EPA has conducted a number of reviews of the effluent sampling, analysis, and bioassay tests. All comments from U.S. EPA have been incorporated into either the Standard Operating Procedures or have been incorporated into the procedures used by the laboratory doing the test, Advanced Biological Testing, Inc., as documented in the March 1995 Technical Memorandum.

The bioassays were originally specified to be conducted using the white shrimp, *Penaeus vannami* (postlarvae). In the event *Penaeus vannami* are not available at the time of the tests, a substitute species, *Mysidopsis bahia*, has been approved by U.S. EPA. Prior to the March 1995 test there was evidence that *Penaeus vannami* would not be available. However, a source of this organism was found. Since the mysids had already been ordered, bioassays were conducted with both *Penaeus vannami* and *Mysidopsis bahia*. The initial lack of availability of *Penaeus vannami* in the previous test had resulted in the same situation. Both tests have provided an opportunity to have a side-by-side test using the two organisms and provide information for the evaluation of the overall bioassay testing study since previous tests have been run with each species and substitution may occur with future tests.

The acute bioassay effluent sampling must be concurrent with effluent sampling for priority pollutant chemical analysis. Effluent samples are to be collected as 24-hour composite samples. The effluent acute bioassay was conducted using a combined composite effluent sample made up from the composite effluent samples from the StarKist Samoa and VCS Samoa Packing facilities, as approved by EPA. This combined effluent bioassay is representative of the wastewater discharged from the joint cannery outfall to Pago Pago Harbor.

Effluent Sampling Methods

Between 1200 on February 01 and 0900 on February 02, 1996, 24-hour, flow-weighted, composite samples of final effluent were collected from both the StarKist Samoa and VCS Samoa Packing treatment plant discharges. Samples were collected from the established effluent sampling sites following the routine composite sample collection schedule for the plants. Detailed sampling procedures were provided in the March 1995 technical memorandum as Attachment II.

A total of eight grab samples were collected into pre-cleaned 1-gallon plastic cubitainers at each plant. Samples were collected at approximately three-hour intervals over a 24 hour

period. The samples were stored on ice until the completion of the 24-hour sampling period. After all samples were collected a flow-proportioned composite sample was prepared. The grab sample collection times and the relative effluent volumes calculated from plant flow records are summarized in Table 1. The relative effluent volumes were used to prepare the final composite sample, which was used to fill the sample container shipped to the laboratory for testing.

A 5-gallon cubitainer containing the composite sample was packed on ice in an ice chest for shipment to the laboratory. Sample chain of custody forms were completed and then sealed into zip-lock bags and taped inside the lid of the ice chest. Samples were shipped via DHL on flights from Pago Pago to Honolulu and then to San Francisco. Samples were delivered to the testing laboratory on 5 February 1996.

Bioassay Testing Procedures

The bioassay tests were conducted by Advanced Biological Testing Inc., Tiburon, California. The testing procedures and results of the bioassay tests are provided in "*Results of a Bioassay Conducted on an Effluent Sample from the Joint Cannery Outfall in American Samoa using Penaeus vannami and Mysidopsis bahia*" dated 1 April 1996 and included as Attachment I. This report summarizes the 96-hour acute bioassay test conducted with reference to U.S. EPA (1991) document *EPA/600/4-90/027* as the source of methods for conducting the test.

The bioassay tests were conducted considering and including U.S. EPA's comments on previous bioassay tests. A brine control was run and a comparison was made with the dilution water "laboratory control". The test organisms were required to be 1 to 5 days old, with a 24-hour range in age and that test temperature be 20 $\pm$ 1 °C or 25 $\pm$ 1 °C. The mysids were 3-day old larvae tested at 25 $\pm$ 2 °C and the penaeids were postlarvae (8 to 10 mm) tested at 20 $\pm$ 2 °C.

Because of the demonstrated potential for a lethal immediate dissolved oxygen demand (IDOD), discussed and documented in previous technical memoranda describing the first two bioassay tests, each bioassay test chamber was continuously aerated during the bioassay tests to maintain adequate levels of dissolved oxygen (DO). Bioassay tests were carried out for effluent concentrations of 50, 25, 12.5, 6.25, and 3.1% for both species as vol:vol dilutions in seawater. Water quality was monitored daily with parameters measured including DO, pH, salinity, temperature, and ammonia. A reference toxicant of sodium dodecyl sulfonate (SDS) was made up of a 2-gram per liter stock solution in distilled water and run at concentrations of 100, 50, 25, 12.5, and 6.25 mg/L in 31 ppt seawater for a 96-hour test.

Results

The results of the bioassay tests are summarized as follows:

***Penaeus vannami* Effluent Bioassay.** All results from the bioassay tests are included in Attachment I. The results of the penaeid 96-hour bioassay indicate the LC_{50} for the effluent tested was >50 percent. The No Observable Effects Concentration (NOEC) for the 96-hour bioassay was >50 percent and the Least Observable Effects Concentration (LOEC) was >50 percent. The calculated value of toxicity unit (TU) was <2.

***Penaeus vannami* Reference Toxicant Bioassay.** The reference toxicant had a LC_{50} of 24 mg/l. The laboratory mean was 21.59 mg/l and the data was slightly over one standard deviation from the laboratory mean, indicating normal sensitivity.

***Mysidopsis bahia* Effluent Bioassay.** All results from the bioassay are included in Attachment I. The results of the mysid 96-hour bioassay tests indicate the LC_{50} for the effluent tested was 28.36 percent (95 percent confidence limits = 21.4 percent to 35.2 percent). The NOEC for the 96-hour bioassay was 12.5 percent and the LOEC was 25 percent. The calculated value of TU was 8.

***Mysidopsis bahia* Reference Toxicant Bioassay.** The reference toxicant had a LC_{50} of 18.3 mg/l. The laboratory mean was 14.29 mg/l, with a standard deviation of 4.11 mg/l. The data was within one standard deviation of the laboratory mean, indicating normal sensitivity.

Discussion

Table 2 summarizes the results of the effluent bioassay tests for the samples collected in the February 1996 sampling compared to the previous bioassay tests. The NOEC and LC_{50} are higher than those obtained for the October 1993, February 1994, and March 1995 penaeid tests. The higher LC_{50} and NOEC for mysids in the test is intermediate between the results for the previous March 95 and October 94 tests.

Conclusions

The results of the bioassay tests for the Joint Cannery Outfall effluent for February 1996 are not considered to be of concern. As discussed in the reports for the previous tests on this effluent, the time scale of the mixing of the effluent with the receiving water is on the order

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The results of the bioassay tests for the Joint Cannery Outfall effluent for February 1996 are not considered to be of concern. As discussed in the reports for the previous tests on this effluent, the time scale of the mixing of the effluent with the receiving water is on the order of minutes to seconds to achieve dilutions that will eliminate possible toxic effects as reflected by the bioassay results. For example an NOEC of 12.5% corresponds to a dilution of 8:1, and a NOEC of >50% corresponds to a dilution of <2:1, which is achieved in a few seconds. The discharge is located in about 180 feet of water and the effluent toxicity tests indicate that the discharge is diluted to non-toxic levels immediately after discharge and the dilution needed to achieve this is well within the initial dilution plume of the discharge.

Table 1
StarKist Samoa and VCS Samoa Packing 24-hour Composite Effluent Sample for Bioassay Testing
01-02 February 1996

Grab Sample Number	VCS Samoa Packing		StarKist Samoa		VCS Samoa Packing Percent of Total Flow	StarKist Samoa Percent of Total Flow
	Sampling Date and Time	Effluent Flow Rate (mgd)	Sampling Date and Time [1]	Effluent Flow Rate (mgd)		
1	2/1/96 1200	0.54	2/1/96 1200	1.19	3.7	8.1
2	1500	0.52	1500	1.33	3.6	9.0
3	1800	0.48	1800	1.75	3.3	12.0
4	2100	0.46	2100	0.84	3.1	5.7
5	2400	0.58	2400	1.05	4.0	7.2
6	2/2/96 0300	0.58	2/2/96 0300	1.30	4.0	8.9
7	0600	0.52	0600	1.68	3.6	11.5
8	0900	0.54	0900	1.26	3.7	8.6
Total		4.22		10.4	29.0	71.0
Mean		0.53		1.30		

[1] Approximate sampling times as exact times not recorded

Table 2
StarKist Samoa and VCS Samoa Packing
Combined Effluent Bioassay Results

Date	*Species*	Parameters		
		LC 50	**NOEC**	**LOEC**
2/93	*Penaeus vannami*	4.8%[1]	3.1%	6.25%
10/93	*Penaeus vannami*	15.67%	3.1%	6.25%
2/94	*Penaeus vannami*	15.76%	<1.6%	1.6%
10/94	*Mysidopsis bahia*[2]	31.2%	25%	50%
3/95	*Penaeus vannami*	14.8%	6.25%	12.5%
3/95	*Mysidopsis bahia*[3]	10.8%	6.25%	12.5%
2/96	*Penaeus vannami*	>50%	>50%	>50%
2/96	*Mysidopsis bahia*[3]	28.36%	12.5%	25%

[1]The February 1993 samples were not aerated until after the first day of the test. For subsequent tests the samples were aerated for the entire duration of the tests.
[2]*Mysidopsis bahia* substitutes as *Penaeus vannami* not available, as directed by U. S. EPA.
[3]*Mysidopsis bahia* used in addition to *Penaeus vannami* as described in text. Only one species is required by the permit conditions.

ATTACHMENT I

LABORATORY REPORT
Advanced Biological Testing
96-hour Acute Bioassay

JOINT CANNERY OUTFALL EFFLUENT SAMPLE
February 1-2, 1996

RESULTS OF BIOASSAYS CONDUCTED ON AN EFFLUENT SAMPLE FROM THE JOINT CANNERY OUTFALL IN AMERICAN SAMOA

Using *Penaeus vannami* and *Mysidopsis bahia*

Prepared for:

CH2M Hill California, Inc.
1111 Broadway
Oakland, CA 94607
Project # PDX 30702

Prepared by:

Advanced Biological Testing Inc.
98 Main St., # 419
Tiburon, Ca. 94920

April 1, 1996

Ref: 9605-1

1.0 INTRODUCTION

At the request of CH2M Hill (Project # PDX 30702), Advanced Biological Testing conducted a four day effluent bioassay test on *Mysidopsis bahia* and *Penaeus vannami* using effluents collected from the joint cannery outfall at the Starkist and Van Camp tuna canneries in American Samoa. The studies were run using methods generally specified in EPA 1991. *Penaeus* is the preferred species according to the NPDES permit, however in previous studies when *Penaeus* was unavailable, *Mysidopsis* was substituted. Since both species have been tested previously separately, it was decided to continue with both species in this test.

The study was conducted at the Advanced Biological Testing Laboratory in Tiburon, California, and was managed by Mr. Mark Fisler.

2.0 METHODS

2.1 EFFLUENT SAMPLING

The effluents were sampled on February 2, 1996 by cannery personnel under the supervision of CH2M Hill. The sample was received by the laboratory on February 5, 1996. One five gallon carboy was provided and maintained in an ice-filled cooler from the date of sampling until laboratory receipt. The sample was at 5°C upon receipt.

2.2 SAMPLE PREPARATION

The salinity of the effluent sample was 14 ppt and required salinity adjustment to 30 ppt. The effluent salinity was increased to 30 ppt with 100 ppt natural seawater brine. The brine was made from frozen Bodega Bay seawater. Due to the dilution of the effluent with the brine solution, the initial maximum concentration of effluent was 80%. The highest initial test concentration was made by diluting the 80% effluent with Bodega Bay seawater to an actual effluent concentration of 50%. The initial total ammonia was approximately 6 ppm (2.98 ppm in the 50% test sample).

The effluents were tested at an actual effluent concentration series of 50%, 25%, 12.5%, 6.25%, and 3.1% for both species as vol:vol dilutions in seawater. A brine control was run with both test sets to assess the potential toxicity from the added brine. The diluent and the control water was filtered seawater from Bodega Bay. The dilutions were brought to the test temperatures (20 and 25 ± 2°C) and aerated continuously. Based upon previous testing, these effluents have an increasing biological oxygen demand, with a significant peak at 10-14 hours after test initiation. Previous testing of this effluent conducted without aeration demonstrated significant toxicity at 24 hours (or before); therefore aeration was carried out from the beginning of the test. According to EPA methods the test chambers were renewed with retained effluents held under refrigeration from test initiation on Day 2.

A reference toxicant was run using concentrations initially provided by the EPA. The toxicant was sodium dodecyl sulfonate (SDS) made up as a 2 grams per liter stock solution in distilled water. The tested concentrations were set at 100, 50, 25, 12.5 and 6.25 mg/L in 31 ppt seawater.

2.3 TESTING PROCEDURES

The bioassays were carried out on three day old larvae of *Mysidopsis bahia* supplied by Aquatox in Arkansas and post-larval *Penaeus* provided by Brezina and Associates. The mysids were received on February 7, 1996 and the penaeids on February 6, 1996. Five replicates of each concentration were tested with ten animals per replicate. Water quality was monitored daily as initial quality on Day 0 and final water quality on Days 1-4. Parameters measured included dissolved oxygen, pH, salinity, total ammonia, and temperature.

2.4 STATISTICAL ANALYSIS

At the conclusion of the test, the survival data were evaluated statistically using ToxCalc™ to determine ECp, NOEC, and LOEC values where appropriate. ToxCalc™ is a comprehensive statistical application that follows standard guidelines for acute toxicity data analysis. Statistical effects can be measured by the ECp, the estimated concentration that causes any effect, either lethal (LC) or sublethal (IC), on p% of the test population. The LCp is the point estimate of the concentration at which a lethal effect is observed in p% of the test organisms. ECp values include 95% confidence limits if calculable. The Toxicity units (TU) are defined as 100/NOEC.

3.0 RESULTS

3.1 INTRODUCTION

Tables 1 through 6 present the data for the *Penaeus* testing and Tables 7 through 12 present the results of the *Mysidopsis* testing.

3.2 *Penaeus vannami*

The test conditions are summarized in Table 1. Water quality measurements were within the acceptable limits provided in EPA 1991. Temperature was maintained at 20 ± 2°C; pH remained relatively stable, and the salinity increased slightly as would be expected in a static test (Tables 2 and 3). Aeration was maintained in all chambers for the duration of the test. The test solutions were renewed with reserved effluent at 48 hrs.

Initial ammonia was 2.98 ppm in the 50% effluent and was proportionally diluted at lower percentage concentrations. At the end of the test the 50% concentration had risen slightly to 3.54 ppm and the lower concentrations were again proportional.

There was little toxicity observed in the penaeid test, with 86% survival in the 50% concentration (Table 4). The LC50 for the effluent was >50%. The NOEC was >50%. The TU was <2.

The reference toxicant test had an LC50 of 24 mg/L (Tables 5 and 6). The laboratory mean was 21.59 mg/L and the data was slightly over one standard deviation from the laboratory mean, indicating normal sensitivity.

3.2 *Mysidopsis bahia*

The test conditions are summarized in Table 7. Water quality measurements were within the acceptable limits provided in EPA 1991. Temperature was maintained at 25 ± 2°C; and the pH remained relatively stable, and the salinity increased very slightly as would be expected in a static test (Tables 8 and 9). Aeration was maintained in all chambers for the duration of the test. The test solutions were renewed with reserved effluent at 48 hrs.

Initial ammonia was 2.98 ppm in the 50% effluent and was proportionally diluted at lower percentage concentrations. At the end of the test the 25% concentration had risen slightly from 1.34 ppm on Day 0 to 1.81 ppm. The lower concentrations were proportional.

The LC50 for the effluent was 28.36% (95% confidence limits = 21.4% to 35.2%). There was significant mortality at the 25% and 50% concentrations compared to the control (Table 10). The NOEC was 12.5%, and the LOEC was 25%. The TU was 8.

The reference toxicant test had an LC50 of 18.3 mg/L (Tables 11 and 12). The laboratory mean for *Mysidopsis bahia* was 14.29 mg/L (SD = 4.11 mg/L). The data is within one standard deviation of the laboratory mean, indicating normal sensitivity.

TABLE 1

Bioassay Procedure And Organism Data For the Survival Bioassay Using *Penaeus vannami* U.S. EPA 1991)

Parameter	Data
Sample Identification	
Sample ID(s)	960205-1
Date Sampled	2/2/96
Date Received at ABT	2/5/96
Volume Received	Five gallons
Sample Storage Conditions	4°C in the dark
Test Species	*Penaeus vannami*
Supplier	J. Brezina and Associates
Collection location	Hawaii
Date Acquired	2/6/96
Acclimation Time	24 hours
Acclimation Water	Shipping water
Acclimation Temperature	20±2°C
Age group	Post larvae (approximately 8-10 mm)
Test Procedures	
Type; Duration	Acute, static/renewal at 48 hours
Test Dates	2/7-11/96
Control Water	Bodega Bay seawater
Test Temperature	20 ± 2°C
Test Photoperiod	16L : 8 D
Salinity	30± 2 ppt
Test Chamber	1000 mL jars
Animals/Replicate	10
Exposure Volume	500 mL
Replicates/Treatment	5
Feeding	Brine shrimp (24 hr old nauplii)
Deviations from procedures	Aerated continuously

TABLE 2

Penaeus vannami
INITIAL WATER QUALITY MEASUREMENTS
FOR EFFLUENT TEST
Initial Readings

Concentration	Day 0					Day 2				
(%)	pH	DO	NH 3	°C	Sal	pH	DO	NH 3	°C	Sal
Control	8.00	8.0	0.01	18.0	30	8.08	7.6	0.01	19.0	30
Brine	8.10	7.9	0.01	18.0	30	7.99	8.4	0.01	20.1	30
3.1	7.98	7.9	0.17	18.0	30	7.71	4.8	0.17	19.5	30
6.25	7.98	7.8	0.35	18.0	30	7.77	6.6	0.34	19.4	30
12.5	7.84	7.6	0.70	18.0	30	7.65	5.2	0.63	19.2	30
25	7.84	7.6	1.34	18.0	30	7.56	4.8	1.21	19.4	30
50	7.80	7.2	2.98	18.0	29	—	—	—	—	—
Min	7.80	7.2	0.01	18.0	29	7.56	4.8	0.01	19.0	30
Max	8.10	8.0	2.98	18.0	30	8.08	8.4	1.21	20.1	30

TABLE 3

Penaeus vannami

FINAL WATER QUALITY MEASUREMENTS FOR EFFLUENT TEST

Concentration		Day 1				Day 2				Day 3				Day 4				
(%)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	NH 3	°C	Sal
Control	1	8.06	7.6	19.2	30	8.08	7.4	19.6	30	8.21	6.3	19.0	30	8.16	7.1	0.09	19.6	30
	2	8.12	7.6	19.1	30	8.14	7.4	19.5	30	8.26	6.1	19.2	30	8.23	7.2		19.8	30
	3	8.09	7.6	19.1	30	8.07	7.4	19.5	30	8.16	6.0	19.1	30	8.10	7.3		19.7	30
	4	8.11	7.6	19.1	30	8.12	7.4	19.4	30	8.24	6.1	19.1	30	8.20	7.1		19.6	30
	5	8.12	7.6	19.1	30	8.13	7.4	19.4	30	8.25	6.0	19.1	30	8.20	7.2		19.6	30
Brine	1	8.23	7.6	19.2	30	8.24	7.5	19.6	30	8.27	6.3	19.2	30	8.37	7.3	0.07	19.9	31
Control	2	8.23	7.6	19.1	30	8.23	7.4	19.4	30	8.37	6.3	19.2	30	8.34	7.1		19.7	30
	3	8.25	7.6	19.1	30	8.25	7.4	19.4	30	8.38	6.2	19.2	30	8.35	7.4		19.6	30
	4	8.25	7.6	19.0	30	8.26	7.4	19.3	30	8.38	6.2	19.1	30	8.36	7.2		19.6	31
	5	8.26	7.6	19.0	30	8.27	7.4	19.3	30	8.39	6.1	19.1	30	8.36	7.2		19.6	31
3.1	1	8.14	7.6	19.1	30	8.13	7.4	19.5	30	8.25	6.4	19.2	30	8.22	7.2	0.37	19.9	30
	2	8.16	7.6	19.0	30	8.17	7.4	19.3	31	8.30	6.2	19.1	31	8.29	7.2		19.7	31
	3	8.18	7.6	19.0	30	8.18	7.4	19.3	31	8.30	6.4	19.1	31	8.28	7.2		19.6	31
	4	8.12	7.6	19.0	30	8.13	7.4	19.3	30	8.25	6.1	19.1	30	8.21	7.0		19.6	31
	5	8.16	7.6	19.0	30	8.17	7.4	19.3	31	8.24	6.3	19.1	31	8.27	7.0		19.6	31
6.25	1	8.15	7.6	19.1	30	8.14	7.4	19.5	30	8.26	6.1	19.2	30	8.26	7.2	0.57	19.9	30
	2	8.12	7.6	19.1	30	8.11	7.4	19.4	30	8.23	6.0	19.2	30	8.22	7.0		19.7	31
	3	8.15	7.6	19.0	30	8.17	7.4	19.3	30	8.28	6.1	19.1	31	8.28	7.2		19.6	31
	4	8.14	7.6	19.1	30	8.16	7.4	19.3	30	8.27	6.1	19.1	30	8.29	7.2		19.6	31
	5	8.15	7.6	19.1	30	8.15	7.4	19.3	30	8.25	6.0	19.1	30	8.12	7.1		19.6	31
12.5	1	8.07	7.6	19.2	30	8.04	7.2	19.5	30	8.18	6.0	19.2	30	8.22	7.0	1.00	19.9	30
	2	8.16	7.6	19.1	30	8.15	7.2	19.4	30	8.30	6.0	19.1	31	8.24	7.1		19.7	30
	3	8.13	7.6	19.1	30	8.14	7.2	19.4	30	8.29	5.9	19.1	30	8.19	7.2		19.8	30
	4	8.10	7.6	19.1	30	8.08	7.0	19.4	30	8.27	5.9	19.1	30	8.27	7.2		19.8	30
	5	8.10	7.6	19.1	30	8.10	7.0	19.4	30	8.23	6.0	19.2	30	8.26	7.0		19.6	30
25	1	8.11	7.6	19.1	30	8.10	7.2	19.5	30	8.28	6.0	19.1	30	8.33	7.0	1.81	19.8	31
	2	8.18	7.4	19.0	30	8.17	7.2	19.3	30	8.33	6.1	19.1	31	8.36	7.0		19.7	32
	3	8.09	7.4	19.1	30	8.09	7.2	19.4	30	8.22	6.0	19.1	30	8.31	7.1		19.7	30
	4	8.05	7.4	19.1	30	8.06	7.2	19.4	30	8.01	6.0	19.2	30	8.29	6.8		19.7	30
	5	8.06	7.4	19.1	30	8.06	7.2	19.5	30	8.30	6.1	19.2	30	8.31	6.8		19.7	30
50	1	8.13	7.2	19.3	30	8.19	7.2	19.6	30	8.36	6.1	19.2	31	8.43	6.4	3.54	19.9	31
	2	8.13	7.0	19.2	30	8.21	7.2	19.5	30	8.30	6.0	19.2	30	8.45	6.8		19.8	31
	3	8.19	7.2	19.2	30	8.25	7.2	19.5	30	8.41	5.9	19.2	31	8.45	6.8		19.9	31
	4	8.15	7.2	19.4	30	8.17	7.0	19.8	30	8.37	6.0	19.4	30	8.33	6.7		19.9	31
	5	8.17	7.1	19.5	30	8.20	7.0	19.9	30	8.42	6.0	19.4	31	8.44	6.7		19.7	31
Min		8.05	7.0	19.0	30	8.04	7.0	19.3	30	8.01	5.9	19.0	30	8.10	6.4	0.07	19.6	30
Max		8.26	7.6	19.5	30	8.27	7.5	19.9	31	8.42	6.4	19.4	31	8.45	7.4	3.54	19.9	32

TABLE 4

Penaeus vannami
SURVIVAL DATA FOR EFFLUENT TEST

Concentration (%)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
Brine Control	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
3.1	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
6.25	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
12.5	1	10	10	10	10	10	100	
	2	10	10	9	9	9	90	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	98.0
25	1	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	100.0
		10	10	10	10	10		
50	1	10	10	10	10	9	90	
	2	10	10	10	10	9	90	
	3	10	10	10	10	9	90	
	4	10	9	9	9	6	60	
	5	10	10	10	10	10	100	86.0

TABLE 5

Penaeus vannami
WATER QUALITY MEASUREMENTS
FOR REFERENCE TOXICANT (S.D.S) TEST

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(mg/L)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal
Control	**1**	8.01	8.0	19.4	30	7.91	6.8	19.4	30	7.93	6.4	19.7	30	7.91	4.5	19.4	30	7.94	5.0	20.1	31
	2					7.93	6.8	19.3	30	7.95	6.4	19.6	30	7.99	4.6	19.3	31	7.93	5.0	19.9	31
	3					7.93	6.8	19.4	30	7.94	6.4	19.7	30	7.98	4.4	19.4	31	7.91	5.0	19.9	31
6.25	**1**	8.01	8.0	19.1	30	7.76	4.8	19.4	30	7.86	6.0	19.7	30	7.95	4.4	19.5	31	7.88	4.5	20.1	31
	2					7.71	4.8	19.3	30	7.82	6.0	19.6	30	7.97	4.5	19.4	31	7.95	4.8	19.9	31
	3					7.72	4.6	19.4	30	7.83	5.8	19.7	30	7.95	4.1	19.4	31	7.85	4.2	20.0	31
12.5	**1**	8.02	8.0	19.1	30	7.57	4.2	19.4	30	7.72	5.2	19.7	30	7.80	3.2	19.5	31	7.79	4.0	20.1	31
	2					7.54	4.2	19.4	30	7.69	5.2	19.6	30	7.78	3.2	19.4	30	7.77	4.0	20.1	31
	3					7.54	4.2	19.4	30	7.69	5.1	19.7	30	7.78	3.4	19.4	31	7.80	4.0	20.1	31
25	**1**	8.02	8.0	19.1	30	7.43	3.9	19.5	30	7.47	4.8	19.9	30	7.61	2.4	19.5	31	7.70	3.5	20.3	31
	2					7.43	3.9	19.4	30	7.46	4.7	19.7	30	7.62	2.5	19.4	31	7.73	3.7	20.2	31
	3					7.44	3.7	19.5	30	7.47	4.7	19.8	30	7.64	2.5	19.4	31	7.73	3.5	20.2	31
50	**1**	8.02	8.0	19.2	30	7.46	4.0	19.6	30	7.39	4.2	19.9	30	7.40	0.1	19.5	31	7.50	1.4	20.1	31
	2					7.50	4.0	19.5	30	7.36	4.4	19.8	30	7.36	0.1	19.5	31	7.46	0.8	20.3	31
	3					7.48	4.0	19.6	30	7.37	4.3	19.9	30	7.38	0.1	19.5	31	7.47	0.5	20.3	31
100	**1**	8.02	8.0	19.7	30	7.45	3.8	19.6	30	—	—	—	—	—	—	—	—	—	—	—	—
	2					7.41	3.7	19.6	30	—	—	—	—	—	—	—	—	—	—	—	—
	3					7.43	3.5	19.7	30	—	—	—	—	—	—	—	—	—	—	—	—
Min		8.01	8.0	19.1	30	7.41	3.5	19.3	30	7.36	4.2	19.6	30	7.36	0.1	19.3	30	7.46	0.5	19.9	31
Max		8.02	8.0	19.7	30	7.93	6.8	19.7	30	7.95	6.4	19.9	30	7.99	4.6	19.5	31	7.95	5.0	20.3	31

Note: — = All animals dead.

TABLE 6

Penaeus vannami
SURVIVAL DATA FOR REFERENCE TOXICANT (S.D.S.) TEST

Concentration (mg/L)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	**1**	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	100.0
6.25	**1**	10	10	10	10	10	100	
	2	10	10	10	10	10	100	
	3	10	10	10	10	10	100	100.0
12.5	**1**	10	10	10	10	10	100	
	2	10	10	9	9	9	90	
	3	10	10	10	10	10	100	96.7
25	**1**	10	10	7	7	5	50	
	2	10	7	3	3	1	10	
	3	10	7	3	3	3	30	30.0
50	**1**	10	6	2	2	2	20	
	2	10	6	4	4	3	30	
	3	10	6	3	3	3	30	26.7
100	**1**	10	0	—	—	—	0	
	2	10	0	—	—	—	0	
	3	10	0	—	—	—	0	0.0

Note: — = All animals dead.

LC50 = 24 mg/L.
Laboratory mean = 21.59 mg/L.

TABLE 7

Bioassay Procedure And Organism Data For the Survival Bioassay Using *Mysidopsis bahia* (U.S. EPA 1991)

Parameter	Data
Sample Identification	
Sample ID(s)	960205-1
Date Sampled	2/2/96
Date Received at ABT	2/5/96
Volume Received	Five gallons
Sample Storage Conditions	4°C in the dark
Test Species	*Mysidopsis bahia*
Supplier	Aquatox, Hot Springs, Arkansas
Collection location	In house colony
Date Acquired	2/7/96
Acclimation Time	Used immediately
Acclimation Water	Shipping water
Acclimation Temperature	25±2°C
Age group	Three day old larvae
Test Procedures	
Type; Duration	Acute, static/renewal at 48 hours
Test Dates	2/7-11/96
Control Water	Bodega Bay seawater
Test Temperature	25± 2°C
Test Photoperiod	14 L : 10 D
Salinity	30± 2 ppt
Test Chamber	1000 mL jars
Animals/Replicate	10
Exposure Volume	500 mL
Replicates/Treatment	5
Feeding	Brine shrimp (<24 hr old nauplii)
Deviations from procedures	None

TABLE 8

Mysidopsis bahia
INITIAL WATER QUALITY MEASUREMENTS
FOR EFFLUENT TEST
Initial Readings

Concentration	Day 0					Day 2			
(%)	pH	DO	NH 3	°C	Sal	pH	DO	°C	Sal
Control	8.00	8.0	0.01	24.2	30	8.09	7.6	24.6	30
Brine	8.10	7.9	0.01	24.2	30	7.98	7.6	24.4	30
3.1	7.98	7.9	0.17	24.3	30	7.67	5.0	24.6	30
6.25	7.98	7.8	0.35	24.2	30	7.69	6.1	24.3	30
12.5	7.84	7.6	0.70	24.3	30	7.64	4.6	24.9	30
25	7.84	7.6	1.34	24.2	30	7.57	4.2	24.9	30
50	7.80	7.2	2.98	24.2	29	—	—	—	—
Min	7.80	7.2	0.01	24.2	29	7.57	4.2	24.3	30
Max	8.10	8.0	2.98	24.3	30	8.09	7.6	24.9	30

TABLE 9

Mysidopsis bahia
FINAL WATER QUALITY MEASUREMENTS FOR EFFLUENT TEST

Concentration		Day 1				Day 2				Day 3				Day 4				
(%)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	NH 3	°C	Sal
Control	1	8.20	7.0	25.3	31	8.20	6.4	25.3	32	8.26	5.8	25.4	31	8.28	6.8	0.09	26.0	32
	2	8.20	6.8	25.3	31	8.21	6.5	25.3	32	8.29	6.0	25.5	31	8.28	6.7		26.1	32
	3	8.19	6.8	25.3	31	8.16	6.5	25.4	32	8.23	5.8	25.6	31	8.22	6.6		26.0	32
	4	8.14	6.8	25.4	31	8.14	6.4	25.4	32	8.17	5.9	25.6	31	8.19	6.5		26.0	32
	5	8.19	6.8	25.6	31	8.21	6.4	25.5	32	8.27	6.0	25.6	31	8.30	6.5		26.0	32
Brine	1	8.31	6.8	25.4	31	8.30	6.4	25.4	31	8.39	6.1	25.6	31	8.36	6.5	0.07	26.0	31
Control	2	8.32	6.8	25.4	31	8.32	6.4	25.4	31	8.37	6.0	25.6	31	8.38	6.4		26.0	31
	3	8.32	6.7	25.4	31	8.32	6.4	25.4	31	8.38	6.0	25.7	31	8.36	6.4		26.1	31
	4	8.30	6.7	25.6	31	8.29	6.4	25.6	31	8.37	6.0	25.7	31	8.38	6.4		26.1	31
	5	8.23	6.6	25.6	31	8.22	6.4	25.6	31	8.25	5.8	25.7	31	8.26	6.4		26.0	31
3.1	1	8.22	6.6	25.5	31	8.21	6.4	25.4	31	8.29	5.9	25.7	31	8.30	6.4	0.32	26.0	31
	2	8.18	6.6	25.6	31	8.18	6.4	25.6	31	8.26	6.0	25.7	31	8.27	6.3		26.1	31
	3	8.22	6.6	25.6	31	8.23	6.4	25.6	31	8.31	6.1	25.8	31	8.30	6.4		26.0	31
	4	8.21	6.6	25.6	31	8.22	6.4	25.6	31	8.28	6.1	25.8	31	8.33	6.4		26.0	31
	5	8.22	6.6	25.7	31	8.23	6.4	25.6	31	8.32	6.0	25.8	31	8.29	6.4		26.0	31
6.25	1	8.23	6.8	25.5	31	8.24	6.4	25.4	31	8.34	6.0	25.7	31	8.35	6.4	0.57	26.1	31
	2	8.20	6.7	25.6	31	8.17	6.4	25.6	31	8.26	6.0	25.9	31	8.31	6.4		26.0	31
	3	8.19	6.6	25.8	31	8.17	6.4	25.6	31	8.25	6.0	25.9	31	8.27	6.4		26.0	31
	4	8.17	6.6	25.8	31	8.16	6.4	25.7	31	8.27	5.8	25.9	31	8.28	6.4		26.0	31
	5	8.22	6.7	25.8	31	8.21	6.4	25.8	31	8.30	6.1	25.9	31	8.32	6.4		26.0	31
12.5	1	8.21	6.6	25.6	31	8.18	6.4	25.6	31	8.28	6.0	25.7	31	8.34	6.4	1.00	26.1	31
	2	8.21	6.6	25.7	31	8.18	6.4	25.6	31	8.31	6.0	25.8	31	8.33	6.4		26.0	31
	3	8.21	6.6	25.8	31	8.22	6.4	25.7	31	8.26	6.0	25.8	31	8.36	6.4		26.0	31
	4	8.19	6.6	25.9	31	8.21	6.4	25.8	31	8.29	5.8	25.9	31	8.35	6.4		26.0	31
	5	8.23	6.6	25.9	31	8.23	6.4	25.8	31	8.27	5.8	25.9	31	8.37	6.4		26.7	31
25	1	8.12	6.4	25.8	31	8.09	6.2	25.7	31	8.16	5.6	25.9	31	8.31	6.2	1.81	26.0	31
	2	8.21	6.4	25.9	31	8.21	6.3	25.8	31	8.29	5.5	25.9	31	8.38	6.2		26.1	31
	3	8.23	6.6	25.8	31	8.26	6.4	25.8	31	8.37	5.5	25.9	31	8.41	6.2		26.1	31
	4	8.24	6.6	25.9	31	8.22	6.4	25.8	31	8.34	5.7	25.9	31	8.40	6.2		26.0	31
	5	8.23	6.5	25.9	31	8.22	6.4	25.9	31	8.32	5.8	25.9	31	8.39	6.2		26.0	31
50	1	8.09	6.2	25.4	31	—	—	—	—	—	—	—	—	—	—	—	—	—
	2	8.07	6.3	25.6	31	—	—	—	—	—	—	—	—	—	—	—	—	—
	3	7.98	6.0	25.5	31	—	—	—	—	—	—	—	—	—	—	—	—	—
	4	7.99	6.0	25.5	31	—	—	—	—	—	—	—	—	—	—	—	—	—
	5	8.27	6.6	25.5	31	8.31	6.4	25.4	32	—	—	—	—	—	—	—	—	—
Min		7.98	6.0	25.3	31	8.09	6.2	25.3	31	8.16	5.5	25.4	31	8.19	6.2	0.07	26.0	31
Max		8.32	7.0	25.9	31	8.32	6.5	25.9	32	8.39	6.1	25.9	31	8.41	6.8	1.81	26.7	32

TABLE 10

Mysidopsis bahia
SURVIVAL DATA FOR EFFLUENT TEST

Concentration (%)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	1	10	10	10	10	9	90	
	2	10	8	8	8	8	80	
	3	10	10	10	9	9	90	
	4	10	10	10	10	9	90	
	5	10	10	10	10	10	100	90.0
Brine Control	1	10	10	8	8	8	80	
	2	10	10	10	9	9	90	
	3	10	10	10	10	9	90	
	4	10	10	10	10	10	100	
	5	10	10	10	10	10	100	92.0
3.1	1	10	10	10	10	10	100	
	2	10	8	7	7	7	70	
	3	10	10	9	8	8	80	
	4	10	10	10	9	8	80	
	5	10	10	10	10	10	100	86.0
6.25	1	10	9	9	9	9	90	
	2	10	10	10	10	10	100	
	3	10	10	10	10	9	90	
	4	10	10	10	10	9	90	
	5	10	10	10	10	9	90	92.0
12.5	1	10	10	7	7	7	70	
	2	10	10	9	9	9	90	
	3	10	10	10	10	10	100	
	4	10	10	10	10	10	100	
	5	10	10	10	10	9	90	90.0
25	1	10	10	10	10	8	80	
	2	10	10	8	8	6	60	
	3	10	10	6	6	4	0	
	4	10	10	6	6	3	30	
	5	10	10	7	7	5	50	44.0
50	1	10	0	—	—	—	0	
	2	10	0	—	—	—	0	
	3	10	0	—	—	—	0	
	4	10	0	—	—	—	0	
	5	10	1	0	—	—	0	0.0

Note: — = All animals dead.

TABLE 11

Mysidopsis bahia
WATER QUALITY MEASUREMENTS
FOR REFERENCE TOXICANT (S.D.S) TEST

Concentration		Day 0				Day 1				Day 2				Day 3				Day 4			
(mg/L)	Rep	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal	pH	DO	°C	Sal
Control	1	8.00	7.6	25.7	30	8.08	6.6	25.4	31	7.94	5.2	25.4	31	7.95	4.2	25.5	31	7.96	5.2	26.2	32
	2					8.08	6.6	25.4	31	7.96	5.4	25.4	31	7.94	4.3	25.6	31	7.95	5.0	26.1	32
	3					8.09	6.6	25.4	31	7.99	5.3	25.4	31	7.95	3.9	25.6	31	7.91	4.6	26.2	32
1.6	1	8.00	7.6	26.0	30	8.06	6.4	25.4	31	7.93	5.0	25.5	31	7.86	3.4	25.6	31	7.91	4.6	26.2	32
	2					8.05	6.4	25.4	31	7.90	4.8	25.5	31	7.94	4.3	25.6	31	7.93	4.8	26.2	32
	3					8.05	6.4	25.4	31	7.92	4.8	25.4	31	7.80	3.0	25.6	31	7.86	4.4	26.1	32
3.1	1	8.00	7.6	26.0	30	8.03	6.2	25.4	31	7.88	4.4	25.5	31	7.86	3.6	25.6	32	7.95	5.0	26.2	32
	2					8.02	6.2	25.4	31	7.93	4.8	25.5	31	7.81	4.0	25.6	31	7.94	5.0	26.3	32
	3					8.02	6.2	25.4	31	7.92	4.6	25.5	31	7.86	3.4	25.6	31	7.89	4.5	26.3	32
6.25	1	8.00	7.6	26.0	30	7.95	5.8	25.6	31	7.86	4.6	25.6	31	7.87	3.8	25.6	32	7.95	4.8	26.2	32
	2					7.94	5.8	25.6	31	7.86	4.6	25.6	31	7.88	3.8	25.6	32	7.95	5.0	26.2	32
	3					7.92	5.5	25.5	31	7.84	4.4	25.4	31	7.81	3.0	25.6	31	7.89	4.6	26.2	32
12.5	1	8.00	7.6	26.0	30	7.77	4.2	25.6	31	7.79	4.6	25.6	31	7.78	3.2	25.6	32	7.84	4.4	26.4	32
	2					7.75	4.2	25.6	31	7.80	4.6	25.6	31	7.78	3.2	25.7	31	7.86	4.4	26.3	32
	3					7.76	4.2	25.6	31	7.85	4.8	25.6	31	7.77	3.0	25.7	31	7.89	4.4	26.3	32
25	1	8.00	7.6	25.9	30	7.62	3.9	25.4	31	7.63	4.2	25.4	31	7.73	3.0	25.4	31	7.78	3.6	26.2	32
	2					7.58	3.9	25.4	31	7.60	4.2	25.4	31	7.75	3.2	25.5	31	7.76	3.6	26.2	32
	3					7.57	3.9	25.4	31	7.55	4.1	25.4	31	7.74	3.4	25.6	31	7.87	5.0	26.2	32
Min		8.00	7.6	25.7	30	7.57	3.9	25.4	31.0	7.55	4.1	25.4	31.0	7.73	3.0	25.4	31.0	7.76	3.6	26.1	32.0
Max		8.00	7.6	26.0	30	8.09	6.6	25.6	31.0	7.99	5.4	25.6	31.0	7.95	4.3	25.7	32.0	7.96	5.2	26.4	32.0

Note: — = All animals dead.

TABLE 12

Mysidopsis bahia
SURVIVAL DATA FOR REFERENCE TOXICANT (S.D.S.) TEST

Concentration (mg/L)	Rep	Initial Added	Day 1	Day 2	Day 3	Day 4	% Survival	Average % Survival
Control	1	10	10	10	10	9	90	
	2	10	10	9	9	9	90	
	3	10	10	9	9	9	90	90.0
1.6	1	10	10	8	8	8	80	
	2	10	10	10	9	9	90	
	3	10	10	10	10	10	100	90.0
3.1	1	10	10	9	8	8	80	
	2	10	10	10	9	9	90	
	3	10	10	10	10	9	90	86.7
6.25	1	10	10	9	9	9	90	
	2	10	10	10	10	10	100	
	3	10	10	8	8	8	80	90.0
12.5	1	10	7	7	7	7	70	
	2	10	7	7	7	7	70	
	3	10	8	6	6	6	60	66.7
25	1	10	2	2	2	2	20	
	2	10	3	3	3	3	30	
	3	10	1	1	1	1	10	20.0

LC50 = 18.3 mg/L.
Laboratory mean = 14.29 mg/L.

4.0
REFERENCES

U.S. EPA. 1991. Methods for measuring acute toxicity of effluents to freshwater and marine organisms, 4th ed. EPA 600/4-90/027, September, 1991.

Rcd 9/9/96
Copy to Mike

Engineers
Planners
Economists
Scientists

6 September 1996

107091.EL.96 (OPE30702)

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa
Environmental Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat and Sheila:

Subject: **VCS Samoa Packing Effluent Chemistry Testing**
Delayed October 1995 Tests
NPDES Permit No. AS0000027

Enclosed are two copies of a Technical Memorandum describing the results of the sixth priority pollutant analyses done under VCS Samoa Packing's NPDES permit requirements. This report covers the effluent sampling done in February 1996 which, as you know, was delayed for reasons explained in the report. I am forwarding the results of the StarKist Samoa analyses under separate cover. The results of the concurrent bioassay tests were mailed on 9 August 1996. The March 1996 sample test results will be mailed within a week. The next tests are scheduled for October 1996.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: James Cox, Van Camp Seafood Company (with 1 copy of enclosure)
Bill Perez, VCS Samoa Packing Company (with 1 copy of enclosure)

9/9/96

TECHNICAL MEMORANDUM CH2M HILL

PREPARED FOR: VCS Samoa Packing Company, Inc. (NPDES Permit AS0000027)

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen Glatzel/Glatzel & Associates

DATE: 29 August 1996

SUBJECT: **Chemical Analysis of Effluent: February 1996 (Delayed Sept/Oct 1995) Sampling**

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the chemical analyses of VCS Samoa Packing effluent samples that were collected in February 1996. The effluent sampling conducted during February 1996 was delayed from the originally scheduled Sept/Oct 1995 sampling.

The sampling and testing initially planned for October 1995 was delayed as a result of problems encountered in shipping laboratory sample containers for the required effluent chemistry tests. International Air Transportation Association (IATA) regulations for the shipment of dangerous goods were revised in the Fall of 1995. The nitric acid preservative used in the metals chemistry bottles falls under these regulations, but an exception based on volume should have applied. The new regulations were confusing for all air cargo shippers using commercial carriers and shipments were refused by the commercial air carrier from Honolulu to American Samoa.

Multiple shipments of sample bottles were attempted using Federal Express, DHL, and Airborne Express. Alternative shipping using private air cargo transport or container ships was subject to further delays because of the schedules of the available shippers between December 1995 and late January 1996. Sample containers were successfully shipped via Triple B Packers at the end of January (the Airborne Express shipment did finally arrive later via New Zealand, but Federal Express and DHL were never successful in transporting shipments using Hawaiian Airlines from Honolulu).

VCS Samoa Packing collected the samples within one week of the arrival of the sample containers. No problems in returning samples to the mainland United States are encountered because the preservative is diluted to the point where it is no longer considered dangerous goods. Attempts to avoid future delays will be made by early shipping and stockpiling sample collection kits in Samoa in advance of the tests. Although the canneries have little storage space available, an attempt will be made to secure an area for sample container storage in the future.

Study Objectives

Section D.2 of VCS Samoa Packing's NPDES permit (AS0000027) requires that semiannual priority pollutant analyses be conducted on the cannery effluent concurrently with bioassay tests. Each effluent sampling event must coincide with effluent sampling for acute biomonitoring. Effluent samples are collected as composite samples as described below. The purpose of these analyses is to identify the chemicals present in the effluent, and provide data to determine whether the wastewater discharge complies with ambient water quality standards.

Effluent priority pollutant analyses include those chemical constituents listed in 40 CFR 401.15. As documented in the Technical Memorandum describing the results of the March 1995 sampling (CH2M HILL, 20 June 1995) the U.S. EPA Region 9 has allowed VCS Samoa Packing to exclude a number of previously measured constituents in the priority pollutant list. The constituents currently included in the effluent chemistry analyses are listed in Table 1.

Methods

Between 1200 on 01 February and 0900 on 02 February 1996, a 24-hour, flow-weighted composite sample of final effluent was collected from the VCS Samoa Packing treatment plant discharge. Effluent composite samples were collected simultaneously for chemistry and bioassay analyses. Table 1 lists the chemical analyses, detection limits, sample holding times, sample containers, and sample preservations for these effluent samples. The standard operating procedures (SOP) for the joint cannery outfall chemistry sampling is provided in the Technical Memorandum describing the bioassay tests conducted with the March 1995 effluent sample (CH2M HILL, 20 June 1995).

Samples were collected from the established effluent sampling site following the routine composite sample collection schedule for the plant. A total of eight individual grab samples were collected into pre-cleaned glass containers at approximately three-hour intervals over a 24 hour period. The samples were stored on ice until the completion of the 24-hour sampling period, and then a flow-weighted composite sample was prepared. The grab sample collection times and the calculated individual volumes of each grab sample used to create the composite sample, based on VCS Samoa Packing's flow records, are summarized in Table 2. The final composite sample was used to fill the sample containers sent to the laboratory for analyses.

Sample containers were wrapped in bubble-wrap, placed in zip-lock bags, and packed on ice for shipment to the laboratory. Sample chain of custody forms were completed, sealed into zip-lock bags, and taped inside the lid of the ice chest. Samples were shipped DHL on flights from Pago Pago to Honolulu and then to San Francisco. Samples that were composited on 03 February, were delivered to GTEL Environmental Laboratories, Inc. on 06 February 1996.

Results

Complete laboratory data sets, laboratory quality control data reports, and chain-of-custody forms are attached to this memorandum. The chain-of-custody form is included as Attachment I and analytical data sheets and quality control data reports are included as Attachment II. Table 1 indicates the method detection limits requested from the analytical laboratory along with those achieved during the analysis. The laboratory indicated prior to sample analysis that the requested detection limits could be achieved. Requested detection limits were achieved for the total phenols, arsenic, cadmium, chromium, lead, silver, and zinc only. Discussions with the laboratory staff will be conducted to address the problems associated with those detection limits achieved. If the problems cannot be resolved, an alternate laboratory that can achieve the requested detection limits will be sought.

As shown in the chain-of-custody form (Attachment I) the laboratory was supposed to measure pH in the metals samples to verify the correct acidification. The laboratory reported a pH in the unpreserved semivolatile sample, which was not requested and not needed. This problem will be corrected in the future.

The analyses conducted detected few chemical parameters in effluent from VCS Samoa Packing. A total of 4 inorganics were detected (arsenic, copper, lead, and zinc) and 3 semivolatile organics were detected: (phenol, 4-methylphenol, and total recoverable phenols). Table 3 summarizes the sample results for the substances detected for the February 1996 effluent sample analysis compared to those detected during previous analyses.

Table 1
Effluent Sample Analyses and Handling Procedures
at VCS Samoa Packing, 01-02 February 1996

Chemical Parameter	Analytical Method	Detection Limits, µg/l		Sample Holding Time	Sample Container	Sample Preservation
		Requested	Achieved			
Semivolatile Organics	EPA 625 and 8270	10-50	100-505	7 days	1 liter amber glass	4 degrees C
Phenols	EPA 420.1	13	5		500 ml plastic	5 ml H_2SO_4
Inorganics[1]						
Arsenic	EPA 206.2	5	10[2]	6 months	500 ml plastic	5 ml 2N HNO_3
Cadmium	EPA 200.7	5	20	"	"	"
Chromium	EPA 200.7	10	30	"	"	"
Copper	EPA 220.2	2	25	"	"	"
Lead	EPA 239.2	5	4	"	"	"
Mercury	EPA 245.1	0.4	1.0	"	"	"
Selenium	EPA 270.1	5	50[2]	"	"	"
Silver	EPA 272.2	2	2	"	"	"
Zinc	EPA 200.7	20	20	"	"	"

[1] All Inorganics were from one 500 ml plastic sample container, using 5ml 2N HNO_3 preservative.
[2] Detection limit raised from 5 µg/l due to matrix interference.

Table 2
Effluent Chemistry 24-hour Composite Sample Collection at VCS Samoa Packing, 01-02 February 1996

Grab Sample Number	Sampling Time	Sampling Date	Effluent Flow Rate (mgd)[1]	Percent of Total Flow	Volume of Sample (ml)	
					1liter	500 ml
1	1200	2/1/96	0.54	12.8	128	64
2	1500	2/1/96	0.52	12.3	123	61.5
3	1800	2/1/96	0.48	11.4	114	57
4	2100	2/1/96	0.46	10.9	109	54.5
5	2400	2/1/96	0.58	13.7	137	68.5
6	0300	2/2/96	0.58	13.7	137	68.5
7	0600	2/2/96	0.52	12.3	123	61.5
8	0900	2/2/96	0.54	12.8	128	64
TOTALS			4.22	99.9	999	499.5

[1] Mean effluent flow rate 0.53 mgd.

Table 3
Summary of VCS Samoa Packing Company Effluent Chemistry Sample Results
01 - 02 February 1996

Substance	Previous Sample Results, µg/L (ppb)					February 1996 Sample Results, µg/L (ppb)
	February 1993	October 1993[1]	February 1994	October 1994	March 1995	
Inorganics						
Arsenic	9.8	ND (15)	25	25	32	14
Copper	21	ND (ND)	13	23	9	54
Lead	4.3	ND (2.5)	ND	ND	ND	5.4
Selenium	ND	ND	22	16	33	<50[2]
Zinc	380	400 (540)	660	760	570	440
Semivolatile organics						
Benzoic Acid	120	ND	ND	ND	ND	ND
Phenol	110	ND	69	120	32	110
4-Methylphenol	670	1600	770	2800	2400	1600
Total Recoverable Phenols	NA	570	84	280	150	170

ND = Not Detected
NA = Not Analyzed
[1] Values in parentheses are results of reanalyzed samples (see Technical Memorandum for October 1993 sampling episode)
[2] Detection limits raised to 50 µg/l because of matrix interference.

ATTACHMENT I

CHAIN OF CUSTODY FORMS

VCS SAMOA PACKING COMPANY, INC. EFFLUENT SAMPLE
February 01 - 02, 1996

CH2M HILL

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project # 107091 EL T6 | Purchase Order # ON FILE

Project Name: VCS SAMOA PACKING-EFFLUENT

Company Name/CH2M HILL Office: CH2M HILL/SFO

Project Manager & Phone #: Mr. [ ] STEVE COSTA; Ms. [ ]; Dr. [X] 510-251-2426(2751)

Report Copy to: STEVE COSTA CH2M HILL/SFO

Requested Completion Date:

Sampling Requirements: SDWA [ ] NPDES [X] RCRA [ ] OTHER [ ]

Sample Disposal: Dispose [ ] Return [ ] SEE BELOW

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	TOTAL PHENOLS EPA 420.1	SEMI VOLATILES EPA 625	PH	ARSENIC EPA 206.2	CADMIUM EPA 200.7	CHROMIUM EPA 200.7	COPPER EPA 220.2	LEAD EPA 239.2	MERCURY EPA 245.1	SELENIUM EPA 270.2	SILVER EPA 272.2	ZINC EPA 200.7	REMARKS	LAB 1 ID	LAB 2 ID
02-01		X		X			~~SKSSV~~	1		X											1l AMBER GLASS	01	
TO 03/01/91		X		X			~~SK~~ VCSPH	1	X		X										500ml PLASTIC w/ H_2SO_4	02	
		X		X			VCSM	1			X	X	X	X	X	X	X	X	X	X	500ml PLASTIC w/ HNO_3	03	

SHADED AREA-- FOR LAB USE ONLY: Lab 1 # | Lab 2 # | Quote # | Kit Request # | Project # | No. of Samples | Page of | Login | LIMS Ver

Sampled By & Title: LAB. SUPV'R. (Please sign and print name): JOYCE - FELICITA PEPITO | Date/Time: 02/02/91 12:00 PM

Relinquished By (Please sign and print name): JOYCE | Date/Time: 02-02-91

Received By (Please sign and print name): JOYCE | Date/Time:

Relinquished By (Please sign and print name): JOYCE | Date/Time:

Received By (Please sign and print name): | Date/Time:

Relinquished By (Please sign and print name): | Date/Time:

Received By (Please sign and print name): C. Hoffman | Date/Time: 2-6-91

Shipped Via: UPS BUS Fed-Ex Hand Other DHL | Shipping # 5300 15846

Work Authorized By (Please sign and print name): S. Costa

Remarks: HOLD METALS FOR POSSIBLE REDOX / SAMPLES W 50% SEAWATER

QC Level: 1 2 3 Other: | COC Rec | ICE | Ana Req | TEMP | Cust Seal | Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340

ATTACHMENT II

LABORATORY DATA REPORT
GTEL Environmental Laboratories, Inc.

VCS SAMOA PACKING COMPANY, INC. EFFLUENT SAMPLE
February 01 - 02, 1996

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

March 11, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS

Dear Steve Costa:

This report, previously dated 02/26/96, is a reissue.

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 02/06/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020101-01	--	--	--
Client ID	VCSSV	--	--	--
Date Sampled	02/01/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/22/96	--	--	--
Dilution Factor	10.0	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
N-Nitrosodimethylamine	10.	ug/L	< 100	--	--	--
Aniline	10.	ug/L	< 100	--	--	--
Phenol	10.	ug/L	110	--	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 100	--	--	--
2-Chlorophenol	10.	ug/L	< 100	--	--	--
1,3-Dichlorobenzene	10.	ug/L	< 100	--	--	--
1,4-Dichlorobenzene	10.	ug/L	< 100	--	--	--
Benzyl Alcohol	10.	ug/L	< 100	--	--	--
1,2-Dichlorobenzene	10.	ug/L	< 100	--	--	--
2-Methylphenol	10.	ug/L	< 100	--	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 100	--	--	--
4-Methylphenol	10.	ug/L	1600	--	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 100	--	--	--
Hexachloroethane	10.	ug/L	< 100	--	--	--
Nitrobenzene	10.	ug/L	< 100	--	--	--
Isophorone	10.	ug/L	< 100	--	--	--
2-Nitrophenol	10.	ug/L	< 100	--	--	--
2,4-Dimethylphenol	10.	ug/L	< 100	--	--	--
Benzoic Acid	50.	ug/L	< 500	--	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 100	--	--	--
2,4-Dichlorophenol	10.	ug/L	< 100	--	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 100	--	--	--
Naphthalene	10.	ug/L	< 100	--	--	--
4-Chloroaniline	50.	ug/L	< 500	--	--	--
Hexachlorobutadiene	10.	ug/L	< 100	--	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 200	--	--	--
2-Methylnaphthalene	10.	ug/L	< 100	--	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 100	--	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 100	--	--	--
2,4,5-Trichlorophenol	10.	ug/L	< 100	--	--	--
2-Chloronaphthalene	10.	ug/L	< 100	--	--	--
2-Nitroaniline	50.	ug/L	< 500	--	--	--
Dimethyl phthalate	10.	ug/L	< 100	--	--	--
Acenaphthylene	10.	ug/L	< 100	--	--	--
2,6-Dinitrotoluene	10.	ug/L	< 100	--	--	--
3-Nitroaniline	10.	ug/L	< 100	--	--	--
Acenaphthene	10.	ug/L	< 100	--	--	--
2,4-Dinitrophenol	50.	ug/L	< 500	--	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020101-01	--	--	--
Client ID	VCSSV	--	--	--
Date Sampled	02/01/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/22/96	--	--	--
Dilution Factor	10.0	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
4-Nitrophenol	50.	ug/L	< 500	--	--	--
Dibenzofuran	10.	ug/L	< 100	--	--	--
2,4-Dinitrotoluene	10.	ug/L	< 100	--	--	--
Diethyl phthalate	10.	ug/L	< 100	--	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 100	--	--	--
Fluorene	10.	ug/L	< 100	--	--	--
4-Nitroaniline	50.	ug/L	< 500	--	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 500	--	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 100	--	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 500	--	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 100	--	--	--
Hexachlorobenzene	10.	ug/L	< 100	--	--	--
Pentachlorophenol	50.	ug/L	< 500	--	--	--
Phenanthrene	10.	ug/L	< 100	--	--	--
Anthracene	10.	ug/L	< 100	--	--	--
Carbazole	10.	ug/L	< 100	--	--	--
Di-n-butyl phthalate	10.	ug/L	< 100	--	--	--
Fluoranthene	10.	ug/L	< 100	--	--	--
Benzidine	50.	ug/L	< 500	--	--	--
Pyrene	10.	ug/L	< 100	--	--	--
Butyl benzyl phthalate	10.	ug/L	< 100	--	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 200	--	--	--
Benzo(a)anthracene	10.	ug/L	< 100	--	--	--
Chrysene	10.	ug/L	< 100	--	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 100	--	--	--
Di-n-octyl phthalate	10.	ug/L	< 100	--	--	--
Benzo(b)fluoranthene	10.	ug/L	< 100	--	--	--
Benzo(k)fluoranthene	10.	ug/L	< 100	--	--	--
Benzo(a)pyrene	10.	ug/L	< 100	--	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 100	--	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 100	--	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 100	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants", Code of Federal Regulations, 40CFR Part 136, Appendix A. 1,2-Diphenylhydrazine is quantified as

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020101-01	--	--	--
Client ID	VCSSV	--	--	--
Date Sampled	02/01/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/22/96	--	--	--
Dilution Factor	10.0	--	--	--

Analyte	Reporting Limit	Units	Concentration:

Notes: (continued)

azobenzene. Sample preparation by liquid/liquid extraction.

W6020101-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogates being outside of acceptabilty limits due to matrix effects.

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

February 26, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS

Dear Steve Costa:

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 02/06/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020101-01	--	--	--
Client ID	VCSSV	--	--	--
Date Sampled	02/01/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/22/96	--	--	--
Dilution Factor	10.0	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
N-Nitrosodimethylamine	10.	ug/L	< 100	--	--	--
Phenol	10.	ug/L	110	--	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 100	--	--	--
2-Chlorophenol	10.	ug/L	< 100	--	--	--
1,3-Dichlorobenzene	10.	ug/L	< 100	--	--	--
1,4-Dichlorobenzene	10.	ug/L	< 100	--	--	--
1,2-Dichlorobenzene	10.	ug/L	< 100	--	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 100	--	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 100	--	--	--
Hexachloroethane	10.	ug/L	< 100	--	--	--
Nitrobenzene	10.	ug/L	< 100	--	--	--
Isophorone	10.	ug/L	< 100	--	--	--
2-Nitrophenol	10.	ug/L	< 100	--	--	--
2,4-Dimethylphenol	10.	ug/L	< 100	--	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 100	--	--	--
2,4-Dichlorophenol	10.	ug/L	< 100	--	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 100	--	--	--
Naphthalene	10.	ug/L	< 100	--	--	--
Hexachlorobutadiene	10.	ug/L	< 100	--	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 200	--	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 100	--	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 100	--	--	--
2-Chloronaphthalene	10.	ug/L	< 100	--	--	--
Dimethyl phthalate	10.	ug/L	< 100	--	--	--
Acenaphthylene	10.	ug/L	< 100	--	--	--
2,6-Dinitrotoluene	10.	ug/L	< 100	--	--	--
Acenaphthene	10.	ug/L	< 100	--	--	--
2,4-Dinitrophenol	50.	ug/L	< 500	--	--	--
4-Nitrophenol	50.	ug/L	< 500	--	--	--
2,4-Dinitrotoluene	10.	ug/L	< 100	--	--	--
Diethyl phthalate	10.	ug/L	< 100	--	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 100	--	--	--
Fluorene	10.	ug/L	< 100	--	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 500	--	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 100	--	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 500	--	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 100	--	--	--
Hexachlorobenzene	10.	ug/L	< 100	--	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6 Method: EPA 625
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6020101-01	--	--	--
Client ID	VCSSV	--	--	--
Date Sampled	02/01/96	--	--	--
Date Prepared	02/07/96			
Date Analyzed	02/22/96	--	--	--
Dilution Factor	10.0	--	--	--

Analyte	Reporting Limit	Units	Concentration:			
Pentachlorophenol	50.	ug/L	< 500	--	--	--
Phenanthrene	10.	ug/L	< 100	--	--	--
Anthracene	10.	ug/L	< 100	--	--	--
Di-n-butyl phthalate	10.	ug/L	< 100	--	--	--
Fluoranthene	10.	ug/L	< 100	--	--	--
Benzidine	50.	ug/L	< 500	--	--	--
Pyrene	10.	ug/L	< 100	--	--	--
Butyl benzyl phthalate	10.	ug/L	< 100	--	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 200	--	--	--
Benzo(a)anthracene	10.	ug/L	< 100	--	--	--
Chrysene	10.	ug/L	< 100	--	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 100	--	--	--
Di-n-octyl phthalate	10.	ug/L	< 100	--	--	--
Benzo(b)fluoranthene	10.	ug/L	< 100	--	--	--
Benzo(k)fluoranthene	10.	ug/L	< 100	--	--	--
Benzo(a)pyrene	10.	ug/L	< 100	--	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 100	--	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 100	--	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 100	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants". Code of Federal Regulations, 40CFR Part 136, Appendix A. 1,2-Diphenylhydrazine is quantified as azobenzene. Sample preparation by liquid/liquid extraction.

W6020101-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogates being outside of acceptabilty limits due to matrix effects.

ANALYTICAL RESULTS
Results For Multiple Methods

GTEL Client ID: CHH02CHH02
Login Number: W6020101
Project ID (number): 107091ELT6
Project ID (name): VCS SAMOA PACKING EFFLUENT/PAGO PAGO/AS

Method: See Below
Matrix: Aqueous

	GTEL Sample Number	W6020101-03	--	--	--
	Client ID	VCSM	--	--	--
	Date Sampled	02/01/96	--	--	--
EPA 200.7	Date Prepared	02/07/96	--	--	--
EPA 200.7	Date Analyzed	02/08/96	--	--	--
EPA 200.7	Dilution Factor	1.00	--	--	--
EPA 206.2	Date Prepared	02/09/96	--	--	--
EPA 206.2	Date Analyzed	02/09/96	--	--	--
EPA 206.2	Dilution Factor	1.00	--	--	--
EPA 239.2	Date Prepared	02/08/96	--	--	--
EPA 239.2	Date Analyzed	02/08/96	--	--	--
EPA 239.2	Dilution Factor	1.00	--	--	--
EPA 245.1	Date Prepared	02/08/96	--	--	--
EPA 245.1	Date Analyzed	02/08/96	--	--	--
EPA 245.1	Dilution Factor	2.00	--	--	--
EPA 270.2	Date Prepared	02/09/96	--	--	--
EPA 270.2	Date Analyzed	02/13/96	--	--	--
EPA 270.2	Dilution Factor	5.00	--	--	--
EPA 272.2	Date Prepared	02/08/96	--	--	--
EPA 272.2	Date Analyzed	02/14/96	--	--	--
EPA 272.2	Dilution Factor	1.00	--	--	--

Analyte		Reporting Limit	Units	Concentration:			
Inorganics (MT, WC)							
Arsenic	EPA 206.2	10.	ug/L	**14.**	--	--	--
Cadmium	EPA 200.7	20.	ug/L	< 20.	--	--	--
Chromium	EPA 200.7	30.	ug/L	< 30.	--	--	--
Copper	EPA 200.7	25.	ug/L	**54.**	--	--	--
Lead	EPA 239.2	4.0	ug/L	**5.4**	--	--	--
Mercury	EPA 245.1	0.50	ug/L	< 1.0	--	--	--
Selenium	EPA 270.2	10.	ug/L	< 50.	--	--	--
Silver	EPA 272.2	2.0	ug/L	< 2.0	--	--	--
Zinc	EPA 200.7	20.	ug/L	**440**	--	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 200.7, EPA 206.2, EPA 239.2, EPA 245.1, EPA 270.2:

Digestion is method specific.

EPA 200.7, EPA 206.2, EPA 239.2, EPA 245.1, EPA 270.2, EPA 272.2:

"Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, USEPA EMSL, Cincinnati, OH, Revised, March 1983.

W6020101-03:

Recovery limits were exceeded for arsenic and selenium in the matrix spike and/or matrix spike duplicate sample(s) due to matrix interference as proven by analytical spike. Recovery limits were exceeded for silver in the matrix spike and/or matrix spike duplicate sample in this analytical batch due to matrix interference as implied by analytical spike.

GTEL Client ID: CHH02.CHH02
Project ID (Number): 107091ELT6
Project ID (Name): VCS Samoa Packing Effluent Pago Pago, AS
Work Order Number: W6-02-0101
Date Reported: 02-21-96

ANALYTICAL RESULTS

Inorganics in Water

GTEL Sample Number			01	02		
Client Identification			VCSSV	VCSPH		
Date Sampled			02-01-96	02-01-96		
Date Analyzed			02-07-96	02-20-96		
Analyte	Method	QL *& Units	Concentration			
pH	EPA 150.1	NA	**6.6[a]**	---		
Total Recoverable Phenols	EPA 420.1	0.005 mg/L	---	**0.17**		

a Data represents the concentration of the sample when analyzed. The method for this analyte requires that it be analyzed immediately upon sampling.

* Quantitation Limit

NA Not applicable

Rcd 10/16/96

Engineers
Planners
Economists
Scientists

11 October 1996

107091.EL.96 (OPE30702)

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa
Environmental Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat and Sheila:

Subject: **StarKist Samoa Effluent Chemistry Testing**
March 1996 Tests
NPDES Permit No. AS0000019

Enclosed are two copies of a Technical Memorandum describing the results of the seventh priority pollutant analyses done under StarKist Samoa's NPDES permit requirements. This report covers the effluent sampling done in March . I am forwarding the results of the VCS Samoa Packing analyses under separate cover. The results of the concurrent bioassay tests were mailed on 9 August 1996. We are working on the reports for the March 1996 sediment monitoring and harbor water quality monitoring results and will forward those to you within about two weeks. The next tests were scheduled for October 1996, but will be delayed until November 1996 in order to facilitate a quick turnaround on our responses to the comments recently received on the Ocean Dumping Model.

As described in the reports for the sixth and seventh effluent chemistry analyses, the laboratory has not performed as requested, and expected, for a few of the metals. This has happened since the laboratory closed its Concord, CA facility which had been running these tests. We are actively trying to resolve this issue with the laboratory. If we can't resolve the problem we will locate an alternate laboratory to run the tests in the future. Please call me if you have any questions about these reports.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: Norman Wei, StarKist Seafood Company (with 1 copy of enclosure)
Barry Mills, StarKist Samoa, Inc. (with 1 copy of enclosure)

CH2M HILL 1111 Broadway, P.O. Box 12681, Oakland, CA 94604-2681 510 251-2426 Fax 510 893-8205

PREPARED FOR: StarKist Samoa, Inc. (NPDES Permit AS0000019)

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen Glatzel/Glatzel & Associates

DATE: 11 October 1996

SUBJECT: **Chemical Analysis of Effluent: March 1996 Sampling**

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the chemical analyses of StarKist Samoa effluent samples that were collected in March 1996. This was the seventh sampling and analysis episode conducted under the current NPDES permit.

Study Objectives

Section D.2 of StarKist Samoa's NPDES permit (AS0000019) requires that semiannual priority pollutant analyses be conducted on the cannery effluent. Each effluent sampling event must coincide with effluent sampling for acute biomonitoring. Effluent samples are collected as composite samples as described below. The purpose of these analyses is to identify the chemicals present in the effluent, and provide data to determine whether the wastewater discharge complies with water quality standards.

Effluent priority pollutant analyses include those chemical constituents listed in 40 CFR 401.15. As documented in the Technical Memorandum describing the results of the March 1995 sampling (CH2M HILL, 20 June 1995) the U.S. Environmental Protection Agency Region 9 has allowed StarKist Samoa to exclude a number of previously measured constituents in the priority pollutant list. The constituents currently included in the effluent chemistry analyses are listed in Table 1.

Methods

Between 1200 on 13 March and 0900 on 14 March 1996, a 24-hour, flow-weighted composite sample of final effluent was collected from the StarKist Samoa treatment plant discharge. Effluent composite samples were collected simultaneously for chemistry and bioassay analyses. Table 1 lists the chemical analyses, detection limits, sample holding times, sample containers, and sample preservations for the effluent sample collected for chemical analysis. The standard operating procedures (SOP) for the joint cannery outfall chemistry sampling is provided in the Technical Memorandum describing the bioassay tests conducted with the March 1995 effluent sample (CH2M HILL, 20 June 1995).

Samples were collected from the established effluent sampling site following the established composite sample collection schedule for the priority pollutant analyses. A total of eight individual grab samples were collected into pre-cleaned glass containers at approximately three-hour intervals over a 24 hour period. The samples were stored on ice until the completion of the 24-hour sampling period, and then a flow-weighted composite sample was prepared. The grab sample collection times and the calculated individual volumes of each grab sample used to create the composite sample, based on StarKist Samoa's flow records, are summarized in Table 2. The final composite sample was used to fill the sample containers sent to the laboratory for analyses. The pH of the sample for analysis of metals was measured prior to shipping and was 1.72.

Sample containers were wrapped in bubble-wrap, placed in zip-lock bags, and packed on ice for shipment to the laboratory. Sample chain of custody forms were completed, sealed into zip-lock bags, and taped inside the lid of the ice chest. Samples were shipped to the laboratory via DHL. Samples that were composited on 14 March, were received at GTEL Environmental Laboratories, Inc. on 20 March 1996.

Results

Laboratory data sets, laboratory quality control data reports, and chain-of-custody forms are attached to this memorandum. The chain-of-custody form is included as Attachment I and analytical data sheets and quality control data reports are included as Attachment II. Table 1 indicates the detection limits requested from the analytical laboratory along with those achieved during the analysis. The laboratory indicated, prior to sample analysis, that the requested detection limits could be achieved. Requested detection limits were achieved for the semivolatiles, total phenols, lead, silver, and zinc only. Discussions with the laboratory staff will be conducted to address the problems associated with those detection limits not achieved. If the problems cannot be resolved, an alternate laboratory that can achieve the requested detection limits will be sought.

The analyses conducted detected few chemical parameters in effluent from StarKist Samoa. One inorganic was detected (zinc) and three semivolatile organics were detected: (phenol, 4-methylphenol, and total recoverable phenols). Table 3 summarizes the sample results for the substances detected for the March 1996 effluent sample analysis compared to those detected during previous analyses.

Table 1
Effluent Sample Analyses and Handling Procedures
at StarKist Samoa, 13 - 14 March 1996

Chemical Parameter	Analytical Method	Detection Limits, µg/l		Sample Holding Time	Sample Container	Sample Preservation
		Requested	Achieved			
Semivolatile Organics	EPA 625	10-50	10-50	7 days	1 liter amber glass	4 °C
Phenols	EPA 420.1	10	10		500 ml plastic	5 ml H_2SO_4
Inorganics [1]						
Arsenic	EPA 206.2	5	400 [2]	6 months	500 ml plastic	4 °C, 5 ml 2N HNO_3 [4]
Cadmium	EPA 200.7	5	20	"	"	"
Chromium	EPA 200.7	10	30	"	"	"
Copper	EPA 220.2	2	25 [3]	"	"	"
Lead	EPA 239.2	5	4	"	"	"
Mercury	EPA 245.1	0.4	1.0	"	"	"
Selenium	EPA 270.1	5	200 [2]	"	"	"
Silver	EPA 272.2	2	2	"	"	"
Zinc	EPA 200.7	20	20	"	"	"

[1] All Inorganics were from one 500 ml plastic sample container, using 5 ml 2N HNO_3 preservative, sample pH measured at 1.72.

[2] Detection limit raised from 5 µg/l and analysis performed using EPA 200.7 because of matrix interference.

[3] Detection limit raised from 2 µg/l and analysis performed using EPA 200.7 because of matrix interference.

[4] Additional HNO_3 was added to the sample as necessary to bring pH equal to or less than 2 at the time of compositing the sample.

Table 2
Effluent Chemistry 24-hour Composite Sample Collection at StarKist Samoa, 13 - 14 March 1996

Grab Sample Number	Sampling Time	Sampling Date	Effluent Flow Rate (mgd)[1]	Percent of Total Flow	Volume of Sample (ml)	
					1 liter	500 ml
1	1200	3/13/96	0.85	11.2	112	56.0
2	1500	3/13/96	0.90	11.9	119	59.5
3	1800	3/13/96	0.90	11.9	119	59.5
4	2100	3/13/96	0.95	12.5	125	62.5
5	2400	3/13/96	0.97	12.9	129	64.5
6	0300	3/14/96	1.00	13.2	132	66.0
7	0600	3/14/96	0.75	9.9	99	49.5
8	0900	3/14/96	1.25	16.5	165	82.5
TOTALS			7.57	100.0	1000	500

[1] Mean Effluent Flow Rate = 0.95 mgd.

Table 3
Summary of StarKist Samoa Effluent Chemistry Sample Results
13 - 14 March 1996

Substance	Previous Sample Results, µg/L (ppb)						March 1996 Sample Results, µg/L (ppb)
	February 1993	October 1993 [1]	February 1994	October 1994	March 1995	February 1996	
Inorganics							
Arsenic	6.0	ND (14)	ND	9	ND [2]	ND	ND [5]
Cadmium	ND	ND	10	ND	ND	ND	ND
Copper	ND	(ND)	15	ND	6	13	ND [6]
Selenium	ND	ND	ND [3]	ND [3]	ND [3]	ND [4]	ND [4]
Silver	130	33 (39)	ND	ND	ND	ND	ND
Zinc	92	130 (180)	140	84	120	63	81
Semivolatile Organics							
Phenol	500	430	45	140	32	32	320
4-Methylphenol	260	530	360	290	310	130	370
Total Recoverable Phenols	NA	1300	120	15	34	72	510

ND = Not Detected
NA = Not Analyzed
[1] Values in parentheses are results of reanalyzed samples (see Technical Memorandum for October 1993 sampling episode).
[2] Detection limit raised to 50 µg/l because of matrix interference.
[3] Detection limit raised to 50 µg/l because of matrix interference, with the resultant concentration < 50 µg/l each time.
[4] Detection limit raised to 200 µg/l because of matrix interference, with the resultant concentration < 200 µg/l each time.
[5] Detection limit raised to 400 µg/l because of matrix interference, with the resultant concentration < 400 µg/l.
[6] Detection limit raised to 25 µg/l because of matrix interference, with the resultant concentration < 25 µg/l.

ATTACHMENT I

CHAIN OF CUSTODY FORM

STARKIST SAMOA, INC. EFFLUENT SAMPLE
13 - 14 March 1996

CH2M HILL

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project # 7070.EL.96 | Purchase Order # O/F

Project Name: EFFLUENT CHEM JCO - Stockist SAMOA

Company Name/CH2M HILL Office: CH2M HILL/SFO

Project Manager & Phone #: Mr. [ ] Ms. [ ] Dr. [X] STEVE COSTA 510-251-2426

Report Copy to: SAME

Requested Completion Date: ASAP

Sampling Requirements: SDWA [ ] NPDES [X] RCRA [ ] OTHER ____

Sample Disposal: SEE BELOW Dispose [ ] Return [ ]

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	Total Phenolics EPA 420.1	Sem. VOs EPA 625	ARSENIC EPA 206.2	CADMIUM - EPA 200.7	CHROMIUM EPA 200.7	COPPER EPA 220.2	Lead EPA 239.2	Mercury EPA 245.1	Selenium EPA 270.2	Silver EPA 272.2	Zinc EPA 200.7
3/14/96	0900	X		X			SK S7 - SVO	1		X									
		X		X			SK S7 - TPH	1	X										
		X		X			SK S7 - MTL	1			X	XX	X	X	X	X	X	X	X

LAB TEST CODES

SHADED AREA FOR LAB USE ONLY

Lab # [redacted] | Bill [redacted]

Quote # [redacted] | Kit Request # [redacted]

Project # [redacted]

No. of Samples [redacted] | Page [redacted] of [redacted]

Login # 01 | LIMS Ver [redacted]

REMARKS: ~ 50% SEAWATER

LAB 1 ID	LAB 2 ID
02	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Sampled By & Title (Please sign and print name)	JIM CRAWFORD	Date/Time	3/14/96
Received By (Please sign and print name)	STEVE COSTA SC	Date/Time	3/15/96
Received By (Please sign and print name)	M. Wind Martha Wind	Date/Time	3/20/96
Received By (Please sign and print name)		Date/Time	
Work Authorized By (Please sign and print name)	SC		

Relinquished By (Please sign and print name)	SAME	Date/Time	
Relinquished By (Please sign and print name)	SAME	Date/Time	
Relinquished By (Please sign and print name)		Date/Time	

Shipped Via: UPS BUS Fed-Ex Hand Other ____ | Shipping #

Remarks: SAVE EXTRA MTLS UNTIL REVIEW NOTE ~ 50% SEAWATER

QC Level: 1 2 3 Other ____ | COC Rec | ICE | Ana Req | TEMP | Cust Seal | PH

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

ATTACHMENT II

LABORATORY DATA REPORT
GTEL Environmental Laboratories, Inc.

STARKIST SAMOA, INC. EFFLUENT SAMPLE
13 - 14 March 1996

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

March 29, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Dear Steve Costa:

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 03/20/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHF
Login Number: W6030370
Project ID (number): 107091.EL.96
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Method: EPA 625
Matrix: Aqueous

GTEL Sample Number	W6030370-02	--	--
Client ID	SKS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:		
N-Nitrosodimethylamine	10.	ug/L	< 10.	--	--
Aniline	10.	ug/L	< 10.	--	--
Phenol	10.	ug/L	320	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 10.	--	--
2-Chlorophenol	10.	ug/L	< 10.	--	--
1,3-Dichlorobenzene	10.	ug/L	< 10.	--	--
1,4-Dichlorobenzene	10.	ug/L	< 10.	--	--
Benzyl Alcohol	10.	ug/L	< 10.	--	--
1,2-Dichlorobenzene	10.	ug/L	< 10.	--	--
2-Methylphenol	10.	ug/L	< 10.	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 10.	--	--
4-Methylphenol	10.	ug/L	370	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 10.	--	--
Hexachloroethane	10.	ug/L	< 10.	--	--
Nitrobenzene	10.	ug/L	< 10.	--	--
Isophorone	10.	ug/L	< 10.	--	--
2-Nitrophenol	10.	ug/L	< 10.	--	--
2,4-Dimethylphenol	10.	ug/L	< 10.	--	--
Benzoic Acid	50.	ug/L	< 50.	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 10.	--	--
2,4-Dichlorophenol	10.	ug/L	< 10.	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 10.	--	--
Naphthalene	10.	ug/L	< 10.	--	--
4-Chloroaniline	50.	ug/L	< 50.	--	--
Hexachlorobutadiene	10.	ug/L	< 10.	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 20.	--	--
2-Methylnaphthalene	10.	ug/L	< 10.	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 10.	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 10.	--	--
2,4,5-Trichlorophenol	10.	ug/L	< 10.	--	--
2-Chloronaphthalene	10.	ug/L	< 10.	--	--
2-Nitroaniline	50.	ug/L	< 50.	--	--
Dimethyl phthalate	10.	ug/L	< 10.	--	--
Acenaphthylene	10.	ug/L	< 10.	--	--
2,6-Dinitrotoluene	10.	ug/L	< 10.	--	--
3-Nitroaniline	10.	ug/L	< 10.	--	--
Acenaphthene	10.	ug/L	< 10.	--	--
2,4-Dinitrophenol	50.	ug/L	< 50.	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6030370-02	--	--
Client ID	SKS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:		
4-Nitrophenol	50.	ug/L	< 50.	--	--
Dibenzofuran	10.	ug/L	< 10.	--	--
2,4-Dinitrotoluene	10.	ug/L	< 10.	--	--
Diethyl phthalate	10.	ug/L	< 10.	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 10.	--	--
Fluorene	10.	ug/L	< 10.	--	--
4-Nitroaniline	50.	ug/L	< 50.	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 50.	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 10.	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 50.	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 10.	--	--
Hexachlorobenzene	10.	ug/L	< 10.	--	--
Pentachlorophenol	50.	ug/L	< 50.	--	--
Phenanthrene	10.	ug/L	< 10.	--	--
Anthracene	10.	ug/L	< 10.	--	--
Carbazole	10.	ug/L	< 10.	--	--
Di-n-butyl phthalate	10.	ug/L	< 10.	--	--
Fluoranthene	10.	ug/L	< 10.	--	--
Benzidine	50.	ug/L	< 50.	--	--
Pyrene	10.	ug/L	< 10.	--	--
Butyl benzyl phthalate	10.	ug/L	< 10.	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 20.	--	--
Benzo(a)anthracene	10.	ug/L	< 10.	--	--
Chrysene	10.	ug/L	< 10.	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 10.	--	--
Di-n-octyl phthalate	10.	ug/L	< 10.	--	--
Benzo(b)fluoranthene	10.	ug/L	< 10.	--	--
Benzo(k)fluoranthene	10.	ug/L	< 10.	--	--
Benzo(a)pyrene	10.	ug/L	< 10.	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 10.	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 10.	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 10.	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants". Code of Federal Regulations. 40CFR Part 136. Appendix A. 1,2-Diphenylhydrazine is quantified as

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

GTEL Sample Number	W6030370-02	--	--
Client ID	SKS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:

Notes: (continued)

azobenzene. Sample preparation by liquid/liquid extraction.

W6030370-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogate recoveries being outside of acceptability limits due to matrix effects.

W6030370-02:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogate recoveries being outside of acceptability limits due to matrix effects.

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Conformance/Non-Conformance Summary

(X = Requirements Met * = See Comments -- = Not Required NA = Not Applicable)

Conformance Item	Volatile Organics	Semi-Volatile Organic	Inorganics (MT, WC)
GC/MS Tune	--	--	NA
Initial Calibration	--	--	--
Continuing Calibration	--	--	--
Surrogate Recovery	--	*	NA
Holding Time	--	X	--
Method Accuracy	--	X	--
Method Precision	--	X	--
Blank Contamination	--	X	--

Comments:

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Surrogate Results

QC Batch No.	Reference	Sample ID	2FP	PHL	NBZ	FBP	TBP	TPH
Method: EPA 625		Acceptability Limits:	21-100%	10- 94%	35-114%	43-116%	10-123%	33-141%
032196BNAW-1	BW032196A1	Method Blank Water	45.4	27.6	55.1	52.6	60.4	64.4
032196BNAW-2	LW032196A1	Laboratory Control	48.4	29.7	66.7	63.8	73.3	58.8
032196BNAW-3	LWD032196A1	LCS Water Duplicat	49.8	31.0	69.7	62.4	80.5	60.8
032196BNAW-4	MS03037203	Matrix Spike	50.3	39.8	61.2	65.4	62.3	58.5
032196BNAW-5	MD03037203	Matrix Spike Dupli	52.0	40.5	62.1	73.8	63.9	63.8
--	03037001	VCS7	39.5	24.0	0.00*	1.73*	51.2	3.30*
--	03037002	SKS7	48.5	37.6	3.19*	2.14*	39.4	3.14*

Notes:

*: Indicates values outside of acceptability limits. See Nonconformance Summary.

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Method Blank Results

QC Batch No: 032196BNAW-1
Date Analyzed: 26-MAR-96

Analyte	Method:EPA 625	Concentration: ug/L
Phenol	< 10.0	
bis(2-Chloroethyl) ether	< 10.0	
2-Chlorophenol	< 10.0	
1,3-Dichlorobenzene	< 10.0	
1,4-Dichlorobenzene	< 10.0	
1,2-Dichlorobenzene	< 10.0	
bis(2-Chloroisopropyl) ether	< 10.0	
N-Nitrosodi-n-propylamine	< 10.0	
Hexachloroethane	< 10.0	
Nitrobenzene	< 10.0	
Isophorone	< 10.0	
2-Nitrophenol	< 10.0	
2,4-Dimethylphenol	< 10.0	
bis(2-Chlorethoxy)methane	< 10.0	
2,4-Dichlorophenol	< 10.0	
1,2,4-Trichlorobenzene	< 10.0	
Naphthalene	< 10.0	
Hexachlorobutadiene	< 10.0	
4-Chloro-3-methylphenol	< 20.0	
Hexachlorocyclopentadiene	< 10.0	
2,4,6-Trichlorophenol	< 10.0	
2-Chloronaphthalene	< 10.0	
Dimethyl phthalate	< 10.0	
Acenaphthylene	< 10.0	
2,6-Dinitrotoluene	< 10.0	
Acenaphthene	< 10.0	
2,4-Dinitrophenol	< 50.0	
4-Nitrophenol	< 50.0	
2,4-Dinitrotoluene	< 10.0	
Diethyl phthalate	< 10.0	
4-Chlorophenyl phenyl ether	< 10.0	
Fluorene	< 10.0	
4,6-Dinitro-2-methylphenol	< 50.0	
N-Nitrosodiphenylamine	< 10.0	
4-Bromophenyl phenyl ether	< 10.0	
Hexachlorobenzene	< 10.0	
Pentachlorophenol	< 50.0	
Phenanthrene	< 10.0	
Anthracene	< 10.0	
Di-n-butyl phthalate	< 10.0	
Fluoranthene	< 10.0	
Pyrene	< 10.0	
Butyl benzyl phthalate	< 10.0	
3,3'-Dichlorobenzidine	< 20.0	

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Method Blank Results

Benzo[a]anthracene	< 10.0
Chrysene	< 10.0
bis(2-Ethyl hexyl) phthalate	< 10.0
Di-n-octyl phthalate	< 10.0
Benzo[b]fluoranthene	< 10.0
Benzo[k]fluoranthene	< 10.0
Benzo[a]pyrene	< 10.0
Indeno[1,2,3-cd]pyrene	< 10.0
Dibenzo[a,h]anthracene	< 10.0
Benzo[g,h,i]perylene	< 10.0

Notes:

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Matrix Spike(MS) and Matrix Spike Duplicate(MSD) Results

GTEL Sample ID: W6030372-03 MS ID: MS03037203 MSD ID: MD03037203
Analysis Date: 26-MAR-96 26-MAR-96 26-MAR-96

Units: ug/L	Sample	Spikes Added		MS	MS	MSD	MSD		Acceptability Limits	
Analyte	Conc.	MS	MSD	Conc.	% Rec.	Conc.	% Rec.	RPD	RPD	%Rec
Phenol	< 10.0(0.000)	189.	189.	77.7	41.1	79.7	42.2	2.60	42	12-110
2-Chlorophenol	< 10.0(0.000)	189.	189.	118.	62.4	123.	65.1	4.20	40	27-123
1,4-Dichlorobenzene	< 10.0(0.000)	189.	189.	121.	64.0	125.	66.1	3.20	28	36-97
N-Nitrosodi-n-propylamine	< 10.0(0.000)	189.	189.	128.	67.7	148.	78.3	14.5	38	41-116
1,2,4-Trichlorobenzene	< 10.0(0.000)	189.	189.	130.	68.8	123.	65.1	5.50	28	39-98
4-Chloro-3-methylphenol	< 20.0(0.000)	189.	189.	112.	59.3	113.	59.8	0.800	42	23-97
Acenaphthene	< 10.0(0.000)	189.	189.	168.	88.9	170.	89.9	1.10	31	46-118
4-Nitrophenol	< 50.0(0.000)	189.	189.	60.4	32.0	54.9	29.0	9.80	50	10-80
2,4-Dinitrotoluene	< 10.0(0.000)	189.	189.	129.	68.3	133.	70.4	3.00	38	24-96
Pentachlorophenol	< 50.0(0.000)	189.	189.	139.	73.5	132.	69.8	5.20	50	9-103
Pyrene	< 10.0(0.000)	189.	189.	149.	78.8	158.	83.6	5.90	31	26-127

Notes:

Values in parentheses in the sample concentration column are used for % recovery calculations.

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

GTEL Client ID: CHH02CHH02 QUALITY CONTROL RESULTS
Login Number: W6030370 Semivolatile Organics
Project ID (number): 107091.EL.96 Method: EPA 625
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS Matrix: Aqueous

Laboratory Control Sample (LCS) and Laboratory Control Duplicate Results

Analyte	Spike Amount	LCS Concentration	LCS Recovery, %	LCS Duplicate Concentration	LCS Duplicate Recovery, %	RPD, %	Acceptability Limits RPD, %	Acceptability Limits Recovery, %
EPA 625 Units: ug/L	QC Batch: 032196BNAW-3							
Phenol	100.	35.0	35.0	33.6	33.6	4.08	42	12-110%
2-Chlorophenol	100.	71.9	71.9	67.9	67.9	5.72	40	27-123%
1,4-Dichlorobenzene	100.	59.7	59.7	63.5	63.5	6.17	28	36- 97%
N-Nitrosodi-n-propylamine	100.	79.6	79.6	71.7	71.7	10.4	38	41-116%
1,2,4-Trichlorobenzene	100.	64.3	64.3	68.8	68.8	6.76	28	39- 98%
4-Chloro-3-methylphenol	100.	72.9	72.9	68.8	68.8	5.79	42	23- 97%
Acenaphthene	100.	90.1	90.1	88.9	88.9	1.34	31	46-118%
4-Nitrophenol	100.	33.8	33.8	31.0	31.0	8.64	50	10- 80%
2,4-Dinitrotoluene	100.	75.2	75.2	72.3	72.3	3.93	38	24- 96%
Pentachlorophenol	100.	87.2	87.2	82.8	82.8	5.18	50	9-103%
Pyrene	100.	79.3	79.3	80.6	80.6	1.63	31	26-127%

Notes:

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

ANALYTICAL RESULTS
Results For Multiple Methods

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96
Project ID (name): STAR KIST SAMOA EFFLUENT/PAGO PAGO/AS

Method: See Below
Matrix: Aqueous

	GTEL Sample Number	W6030370-02	--	--
	Client ID	SKS7	--	--
	Date Sampled	03/14/96	--	--
EPA 200.7	Date Prepared	03/21/96	--	--
EPA 200.7	Date Analyzed	03/21/96	--	--
EPA 200.7	Dilution Factor	1.00	--	--
EPA 239.2	Date Prepared	03/27/96	--	--
EPA 239.2	Date Analyzed	03/27/96	--	--
EPA 239.2	Dilution Factor	1.00	--	--
EPA 245.1	Date Prepared	03/22/96	--	--
EPA 245.1	Date Analyzed	03/22/96	--	--
EPA 245.1	Dilution Factor	2.00	--	--
EPA 272.2	Date Prepared	03/27/96	--	--
EPA 272.2	Date Analyzed	03/28/96	--	--
EPA 272.2	Dilution Factor	1.00	--	--

Analyte		Reporting Limit	Units	Concentration:		
Inorganics (MT, WC)						
Arsenic	EPA 200.7	400	ug/L	< 400	--	--
Cadmium	EPA 200.7	20.	ug/L	< 20.	--	--
Chromium	EPA 200.7	30.	ug/L	< 30.	--	--
Copper	EPA 200.7	25.	ug/L	< 25.	--	--
Lead	EPA 239.2	4.0	ug/L	< 4.0	--	--
Mercury	EPA 245.1	0.50	ug/L	< 1.0	--	--
Selenium	EPA 200.7	200	ug/L	< 200	--	--
Silver	EPA 272.2	2.0	ug/L	< 2.0	--	--
Zinc	EPA 200.7	20.	ug/L	81.	--	--

Notes

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 200.7, EPA 239.2, EPA 245.1:

Digestion is method specific.

EPA 200.7, EPA 239.2, EPA 245.1, EPA 272.2:

"Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, USEPA EMSL, Cincinnati, OH, Revised, March 1983.

W6030370-01:

Analyzed for arsenic and selenium by EPA Method 200.7 due to matrix interference on the graphite furnace. Dilutions to overcome these interferences would have raised the reporting limit above that of EPA Method 200.7.

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: 6-03-0370
Date Reported: 03-29-96

QA NONCONFORMANCE SUMMARY

1.0 Sample Handling

1.1 Sample handling and holding time criteria were not met for zero samples.

2.0 Initial Calibration Verification

2.1 The validity for the calibration verification was exceeded for zero samples as shown in Table 2.

3.0 Method Blanks

3.1 Zero target elements were found in the method blank as shown in Table 3.

4.0 Matrix Spike (MS) Accuracy

4.1 The recovery limits were exceeded in the matrix spike and matrix spike duplicate for two elements as shown in Table 4A and Table 4B.

4.2 Recovery limits were exceeded for chromium and zinc in the matrix spike and/or matrix spike duplicate sample(s) due to high concentrations of dissolved solids.

5.0 Sample Duplicate Precision

5.1 The maximum percent difference (RPD) was exceeded for zero elements in the matrix spike and matrix spike duplicate samples as shown in Table 4A and Table 4B.

6.0 Laboratory Control Sample

6.1 The recovery limits were not met for zero elements for the laboratory control samples as shown in Table 5.

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 2

INITIAL CALIBRATION VERIFICATION QC CHECK SAMPLE REPORT

Metals in Water[a]

Analyte	Expected Result, ug/L	Observed Result, ug/L	Recovery, %	Acceptability Limits, %[a]
Arsenic	1000	972	97.2	95-105
Cadmium	1000	981	98.1	95-105
Chromium	996	988	99.2	95-105
Copper	1000	987	98.7	95-105
Lead	20.0	21.6	106	90-110
Mercury	4.00	4.03	101	90-110
Selenium	1000	970	97.0	95-105
Silver	2.00	1.98	99.0	90-110
Zinc	1000	998	99.8	95-105

a Acceptability limits as per EPA Contract Laboratory Program

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 3

BLANK REPORT

Metals in Water

Analyte	Initial Calibration Blank, ug/L	Preparation Blank, ug/L
Arsenic	<400	<400
Cadmium	<20	<20
Chromium	<30	<30
Copper	<25	<25
Lead	<4.0	<4.0
Mercury	<1.0	<1.0
Selenium	<200	<200
Silver	<2.0	<2.0
Zinc	<20	<20

<# Not detected at the indicated detection limit (#)

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 4A

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

Metals in Water

Sample Spiked: Method 239.2 and 272.2 - W6-03-0365-03
Sample Spiked: Method 245.1 - W6-03-0370-01
Sample Spiked: Method 200.7 - W6-03-0364-02

Analyte	Spike Added, ug/L	Sample Concentration, ug/L	MS Concentration, ug/L	MS Percent Recovery	Acceptability Limits, %[a]
Arsenic	2000	<400	1760	88.3	80-120
Cadmium	1000	<20.0	831	83.1	80-120
Chromium	400	<30.0	301	75.2[b]	80-120
Copper	400	<25.0	340	85.1	80-120
Lead	20.0	6.40	26.2	99.0	75-125
Mercury	2.00	<1.00	1.67	83.5	75-125
Selenium	1990	<200	1760	88.1	80-120
Silver	2.50	<1.00	2.63	105	80-120
Zinc	2000	<20.0	1600	80.0	75-125

a Acceptability limits as per EPA Contract Laboratory Program.

b Value outside acceptability limits.

NA Not applicable; inititial sample concentration greater than four times spike amount.

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 4B

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

Metals in Water

Analyte	Spike Added, ug/L	MSD Concentration, ug/L	MSD Percent Recovery	RPD %	Acceptability Limits, %[a]	
					RPD	% Recovery
Arsenic	2000	1670	83.3	5.74	20.0	80-120
Cadmium	1000	807	80.7	2.87	20.0	80-120
Chromium	400	296	73.9[b]	1.74	20.0	80-120
Copper	400	327	81.8	4.01	20.0	75-125
Lead	20.0	26.5	100	1.50	20.0	75-125
Mercury	2.00	1.52	76.0	9.40	20.0	80-120
Selenium	1990	1680	84.4	4.33	20.0	80-120
Silver	2.50	2.39	95.6	9.37	20.0	75-125
Zinc	2000	1540	77.2[b]	3.32	20.0	80-120

a Acceptability limits as per EPA Contract Laboratory Program.

b Value outside acceptability limits.

NA Not applicable; inititial sample concentration greater than four times spike amount.

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 5

LABORATORY CONTROL SAMPLE RESULTS

Metals in Water

Analyte	Expected Result, ug/L	Observed Result, ug/L	Recovery, %	Acceptability Limits, %[a]
Arsenic	2000	2040	102	80-120
Cadmium	1000	1010	101	80-120
Chromium	400	417	104	80-120
Copper	400	418	104	80-120
Lead	20.0	21.9	110	75-125
Mercury	2.00	1.71	85.5	75-125
Selenium	1990	1980	99.2	80-120
Silver	2.50	2.24	89.6	75-125
Zinc	2000	2050	102	80-120

a Acceptability limits established by laboratory practice

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: [illegible]-03-0370
Date Reported: 03-29-96

ANALYTICAL RESULTS

Inorganics

GTEL Sample Number				02		
Client Identification				SKS7		
Date Sampled				03-14-96		
Date Analyzed				03-22-96		
Analyte	Method	QL* & Units		Concentration		
Total Recoverable Phenols	EPA 420.1	0.01 mg/L		**0.51**		

a Distillation by 350.2.

* Quantitation Limit

Project ID (Number): CHH02.CHH02
Project ID (Name): Star Kist Samoa Effluent
Pago Pago, AS
Work Order Number: W6-03-0370
Date Reported: 03-29-96

QA NONCONFORMANCE SUMMARY

Inorganics

1.0 Sample Handling

1.1 Sample handling and holding time criteria were not met for **0** samples.

2.0 Initial Calibration Verification

2.1 The criteria for the calibration verification QC Check Sample was exceeded for **0** samples as shown in Table 2.

3.0 Method Blanks

3.1 **Zero** target analytes were found in the method blank as shown in Table 3.

4.0 Matrix Spike (MS) Accuracy

4.1 The recovery limits were exceeded in the matrix spike for **0** analyte as shown in Table 4.

5.0 Sample Duplicate Precision

5.1 The maximum percent difference (RPD) was exceeded for **0** analytes in the duplicate samples as shown in Table 5.

6.0 Laboratory Control Sample

6.1 The recovery limits were not met for 0 analytes in the Laboratory Control Sample as shown in Table 6.

Table 2

INITIAL CALIBRATION VERIFICATION QC CHECK SAMPLE REPORT

Inorganics

Analyte	Expected Result	Observed Result	Units	Recovery, %	Acceptability Limits, %[a]
Total Recoverable Phenols	0.010	0.0103	mg/L	103	90-110
					90-110

a Acceptability limits established by laboratory practice.

Table 3

BLANK REPORT

Inorganics

Analyte	Initial Calibration Blank	Preparation Blank	Units
Total Recoverable Phenols	<0.01	<0.01	mg/L

Table 4

MATRIX SPIKE (MS) RECOVERY SUMMARY

Inorganics

Sample Spiked: W6-03-0346-01

Analyte	MS Sample Result	Sample Result	Amount Added	Units	MS, % Recovery	Acceptability Limits, %[a]
Total Recoverable Phenols	0.0376	<0.01	0.04	mg/L	93.9	80-120

a Acceptability limits established by laboratory practice.

Table 5

LABORATORY DUPLICATE SAMPLE RESULTS
AND RELATIVE PERCENT DIFFERENCE (RPD) SUMMARY

Inorganics

Analyte	Matrix Spike Result	Matrix Spike Duplicate Result	Units	RPD, %	Maximum RPD, %[a]
Total Recoverable Phenols	0.0376	0.0375	mg/L	0.079	20

a Acceptability limits established by laboratory practice.

Table 6

LABORATORY CONTROL SAMPLE RESULTS

Inorganics

Analyte	Expected Result	Observed Result	Units	Recovery, %	Acceptability Limits, %[a]
Total Recoverable Phenols	0.04	0.037	mg/L	92.4	80-120

a Acceptability limits established by laboratory practice

Rcd 10/16/96

Engineers
Planners
Economists
Scientists

11 October 1996

107091.EL.96 (OPE30702)

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa
Environmental Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat and Sheila:

Subject: **VCS Samoa Packing Effluent Chemistry Testing**
March 1996 Tests
NPDES Permit No. AS0000027

Enclosed are two copies of a Technical Memorandum describing the results of the seventh priority pollutant analyses done under VCS Samoa Packing's NPDES permit requirements. This report covers the effluent sampling done in March . I am forwarding the results of the StarKist Samoa analyses under separate cover. The results of the concurrent bioassay tests were mailed on 9 August 1996. We are working on the reports for the March 1996 sediment monitoring and harbor water quality monitoring results and will forward those to you within about two weeks. The next tests were scheduled for October 1996, but will be delayed until November 1996 in order to facilitate a quick turnaround on our responses to the comments recently received on the Ocean Dumping Model.

As described in the reports for the sixth and seventh effluent chemistry analyses, the laboratory has not performed as requested, and expected, for a few of the metals. This has happened since the laboratory closed its Concord, CA facility which had been running these tests. We are actively trying to resolve this issue with the laboratory. If we can't resolve the problem we will locate an alternate laboratory to run the tests in the future. Please call me if you have any questions about these reports.

Sincerely,

CH2M HILL

Steven L. Costa
Project Manager

cc: James Cox, Van Camp Seafood Company (with 1 copy of enclosure)
Bill Perez, VCS Samoa Packing Company (with 1 copy of enclosure)

CH2M HILL 1111 Broadway, P.O. Box 12681, Oakland, CA 94604-2681 510 251-2426 Fax 510 893-8205

PREPARED FOR: VCS Samoa Packing Company, Inc. (NPDES Permit AS0000027)

PREPARED BY: Steve Costa/CH2M HILL/SFO
Karen Glatzel/Glatzel & Associates

DATE: 11 October 1996

SUBJECT: **Chemical Analysis of Effluent: March 1996 Sampling**

PROJECT: 107091.EL.96

Purpose

This memorandum presents the results of the chemical analyses of VCS Samoa Packing effluent samples that were collected in March 1996. This was the seventh sampling and analysis episode conducted under the current NPDES permit.

Study Objectives

Section D.2 of VCS Samoa Packing's NPDES permit (AS0000027) requires that semiannual priority pollutant analyses be conducted on the cannery effluent concurrently with bioassay tests. Each effluent sampling event must coincide with effluent sampling for acute biomonitoring. Effluent samples are collected as composite samples as described below. The purpose of these analyses is to identify the chemicals present in the effluent, and provide data to determine whether the wastewater discharge complies with water quality standards.

Effluent priority pollutant analyses include those chemical constituents listed in 40 CFR 401.15. As documented in the Technical Memorandum describing the results of the March 1995 sampling (CH2M HILL, 20 June 1995) the U.S. Environmental Protection Agency Region 9 has allowed VCS Samoa Packing to exclude a number of previously measured constituents in the priority pollutant list. The constituents currently included in the effluent chemistry analyses are listed in Table 1.

Methods

Between 1200 on 13 March and 0900 on 14 March 1996, a 24-hour, flow-weighted composite sample of final effluent was collected from the VCS Samoa Packing treatment plant discharge. Effluent composite samples were collected simultaneously for chemistry and bioassay analyses. Table 1 lists the chemical analyses, detection limits, sample holding times, sample containers, and sample preservations for the effluent sample collected for chemical analysis. The standard operating procedures (SOP) for the joint cannery outfall chemistry sampling is provided in the Technical Memorandum describing the bioassay tests conducted with the March 1995 effluent sample (CH2M HILL, 20 June 1995).

Samples were collected from the established effluent sampling site following the established composite sample collection schedule for the priority pollutant analyses. A total of eight individual grab samples were collected into pre-cleaned glass containers at approximately three-hour intervals over a 24 hour period. The samples were stored on ice until the completion of the 24-hour sampling period, and then a flow-weighted composite sample was prepared. The grab sample collection times and the calculated individual volumes of each grab sample used to create the composite sample, based on VCS Samoa Packing's flow records, are summarized in Table 2. The final composite sample was used to fill the sample containers sent to the laboratory for analyses. The pH of the sample for analysis of metals was measured prior to shipping and was 1.65.

Sample containers were wrapped in bubble-wrap, placed in zip-lock bags, and packed on ice for shipment to the laboratory. Sample chain of custody forms were completed, sealed into zip-lock bags, and taped inside the lid of the ice chest. Samples were shipped to the laboratory via DHL. Samples that were composited on 14 March, were received at GTEL Environmental Laboratories, Inc. on 20 March 1996.

Results

Laboratory data sets, laboratory quality control data reports, and chain-of-custody forms are attached to this memorandum. The chain-of-custody form is included as Attachment I and analytical data sheets and quality control data reports are included as Attachment II. Table 1 indicates the detection limits requested from the analytical laboratory along with those achieved during the analysis. The laboratory indicated, prior to sample analysis, that the requested detection limits could be achieved. Requested detection limits were achieved for the total phenols, lead, silver, and zinc only. Discussions with the laboratory staff will be conducted to address the problems associated with those detection limits not achieved. If the problems cannot be resolved, an alternate laboratory that can achieve the requested detection limits will be sought.

The analyses conducted detected few chemical parameters in effluent from VCS Samoa Packing. One inorganic was detected (zinc) and three semivolatile organics were detected: (phenol, 4-methylphenol, and total recoverable phenols). Table 3 summarizes the sample results for the substances detected for the March 1996 effluent sample analysis compared to those detected during previous analyses. As noted in Table 3, the reporting limits for arsensic, copper, and selenium were high due to matrix interference preventing comparison with previous sample results.

Table 1
Effluent Sample Analyses and Handling Procedures
at VCS Samoa Packing, 13 - 14 March 1996

Chemical Parameter	Analytical Method	Detection Limits, µg/l		Sample Holding Time	Sample Container	Sample Preservation
		Requested	Achieved			
Semivolatile Organics	EPA 625	10-50	100-505	7 days	1 liter amber glass	4 °C
Phenols	EPA 420.1	10	10		500 ml plastic	5 ml H_2SO_4
Inorganics [1]						
Arsenic	EPA 206.2	5	400 [2]	6 months	500 ml plastic	4 °C, 5 ml 2N HNO_3 [4]
Cadmium	EPA 200.7	5	20	"	"	"
Chromium	EPA 200.7	10	30	"	"	"
Copper	EPA 220.2	2	25 [3]	"	"	"
Lead	EPA 239.2	5	4	"	"	"
Mercury	EPA 245.1	0.4	1.0	"	"	"
Selenium	EPA 270.1	5	200 [2]	"	"	"
Silver	EPA 272.2	2	2	"	"	"
Zinc	EPA 200.7	20	20	"	"	"

[1] All Inorganics were from one 500 ml plastic sample container, using 5 ml 2N HNO_3 preservative, with pH of filled sample bottle measured at 1.65.

[2] Detection limit raised from 5 µg/l and analysis performed using EPA 200.7 because of matrix interference.

[3] Detection limit raised from 2 µg/l and analysis performed using EPA 200.7 because of matrix interference.

[4] Additional HNO_3 was added to the sample as necessary to bring pH equal to or less than 2 at the time of composting the sample.

Table 2
Effluent Chemistry 24-hour Composite Sample Collection at VCS Samoa Packing, 13 - 14 March 1996

Grab Sample Number	Sampling Time	Sampling Date	Effluent Flow Rate (mgd)[1]	Percent of Total Flow	Volume of Sample (ml)	
					1 liter	500 ml
1	1200	3/13/96	0.56	12.9	129	64.5
2	1500	3/13/96	0.52	12.0	120	60.0
3	1800	3/13/96	0.52	12.0	120	60.0
4	2100	3/13/96	0.50	11.5	115	57.5
5	2400	3/13/96	0.52	12.0	120	60.0
6	0300	3/14/96	0.60	13.8	138	69.0
7	0600	3/14/96	0.60	13.8	138	69.0
8	0900	3/14/96	0.52	12.0	120	60.0
TOTALS			4.34	100.0	1000	500

[1] Mean effluent flow rate 0.54 mgd.

Table 3
Summary of VCS Samoa Packing Effluent Chemistry Sample Results
13 - 14 March 1996

Substance	Previous Sample Results, µg/L (ppb)						March 1996 Sample Results, µg/L (ppb)
	February 1993	October 1993 [1]	February 1994	October 1994	March 1995	February 1996	
Inorganics							
Arsenic	9.8	ND (15)	25	25	32	14	ND [3]
Copper	21	(ND) (ND)	13	23	9	54	ND [4]
Lead	4.3	ND (2.5)	ND	ND	ND	5.4	ND
Silver	ND	ND	22	16	33	<50 [2]	ND [5]
Zinc	380	400 (540)	660	760	570	440	740
Semivolatile Organics							
Benzoic Acid	120	ND	ND	ND	ND	ND	ND
Phenol	110	ND	69	120	32	110	89
4-Methylphenol	670	1600	770	2800	2400	1600	6800
Total Recoverable Phenols	NA	570	84	280	150	170	170

ND = Not Detected
NA = Not Analyzed

Values in parentheses are results of reanalyzed samples (see Technical Memorandum for October 1993 sampling episode).

[2] Detection limit raised to 50 µg/l because of matrix interference, with the resultant concentration <50 µg/l each time.

[3] Detection limit raised to 400 µg/l because of matrix interference, with the resultant concentration <400 µg/l each time.

[4] Detection limit raised to 25 µg/l because of matrix interference, with the resultant concentration <25 µg/l.

[5] Detection limit raised to 200 µg/l because of matrix interference, with the resultant concentration <200 µg/l.

ATTACHMENT I

CHAIN OF CUSTODY FORM

VCS SAMOA PACKING COMPANY, INC. EFFLUENT SAMPLE
March 13 - 14, 1996

PAGE 3 of 4

CH2M HILL

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Bill Project # 30941.EL.06

Purchase Order # O/F

Project Name: EFFLUENT CHEM SCO - VCS SAMOA PACKING

Company Name/CH2M HILL Office: SFO — CH2M HILL/SFO

Project Manager & Phone #: Mr. [ ] Steve Costa; Ms. [ ]; Dr. [ ] 510-251-2426

Report Copy to: SAME

Requested Completion Date: ASAP

Sampling Requirements: SDWA [ ] NPDES [X] RCRA [ ] OTHER [ ]

Sample Disposal: SEE BELOW — Dispose [ ] Return [ ]

LAB TEST CODES

SHADED AREA FOR LAB USE ONLY — Lab # | Rec'd By | Quote # | Kit Request # | Project # | No. of Samples | Page | of | Login | LIMS Ver | REMARKS | LAB 1 ID | LAB 2 ID

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	Total Phenolics EPA 420.1	Sem. Volatiles EPA 625	Arsenic EPA 206.2	Cadmium EPA 200.7	Chromium EPA 200.7	Copper EPA 220.2	Lead EPA 239.2	Mercury EPA 245.1	Selenium EPA 270.2	Silver EPA 272.2	Zinc EPA 200.7	REMARKS	LAB 1 ID	LAB 2 ID
3/14/96	0900	X		X			VCS7-SVO	1		X										~~ANALYZE SOIL~~ ~~SEMIVOLATILES~~ SCC	01	~~22~~ 22
		X		X			VCS7-TPH	1	X												
		X		X			VCS7-MTL	1			X	X	X	X	X	X	X	X	X		

Sampled By & Title (Please sign and print name)	Jim CRAWFORD	Date/Time	3/14/96
Received By (Please sign and print name)	STEVE COSTA SCC	Date/Time	3/15/96
Received By (Please sign and print name)	M Ward	Date/Time	3/20/96
Received By (Please sign and print name)		Date/Time	
Work Authorized By (Please sign and print name)	SCC		

Relinquished By (Please sign and print name)	SAME	Date/Time	
Relinquished By (Please sign and print name)	SAME	Date/Time	
Relinquished By (Please sign and print name)		Date/Time	
Shipped Via	UPS BUS Fed-Ex Hand Other	Shipping #	

QC Level: 1 2 3 Other:

COC Rec | ICE

Ana Req | TEMP

Cust Seal | PH

Remarks: SAVE ~~BE~~ EXTRA MTLS UNTIL REVIEW — ~~VOA~~ ~~SEMIVOLATILES~~ SCC

13°C

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340

ATTACHMENT II

LABORATORY DATA REPORT
GTEL Environmental Laboratories, Inc.

VCS SAMOA PACKING COMPANY, INC. EFFLUENT SAMPLE
March 13 - 14, 1996

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

Midwest Region
4211 May Avenue
Wichita, KS 67209
(316) 945-2624
(800) 633-7936
(316) 945-0506 (FAX)

March 29, 1996

Steve Costa
CH2M Hill
1111 Broadway #1200
Oakland, CA 94607

RE: GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

Dear Steve Costa:

Enclosed please find the analytical results for the samples received by GTEL Environmental Laboratories, Inc. on 03/20/96.

A formal Quality Assurance/Quality Control (QA/QC) program is maintained by GTEL, which is designed to meet or exceed the EPA requirements. Analytical work for this project met QA/QC criteria unless otherwise stated in the footnotes. This report is to be reproduced only in full.

GTEL is certified by the State of Kansas under Certification Numbers E-103, E-1113.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,
GTEL Environmental Laboratories, Inc.

Terry R. Loucks
Laboratory Director

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

Method: EPA 625
Matrix: Aqueous

GTEL Sample Number	W6030370-01	--	--
Client ID	VCS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:		
N-Nitrosodimethylamine	10.	ug/L	< 10.	--	--
Aniline	10.	ug/L	< 10.	--	--
Phenol	10.	ug/L	89.	--	--
bis(2-Chloroethyl) ether	10.	ug/L	< 10.	--	--
2-Chlorophenol	10.	ug/L	< 10.	--	--
1,3-Dichlorobenzene	10.	ug/L	< 10.	--	--
1,4-Dichlorobenzene	10.	ug/L	< 10.	--	--
Benzyl Alcohol	10.	ug/L	< 10.	--	--
1,2-Dichlorobenzene	10.	ug/L	< 10.	--	--
2-Methylphenol	10.	ug/L	< 10.	--	--
bis(2-Chloroisopropyl) ether	10.	ug/L	< 10.	--	--
4-Methylphenol	10.	ug/L	6800	--	--
N-Nitrosodi-n-propylamine	10.	ug/L	< 10.	--	--
Hexachloroethane	10.	ug/L	< 10.	--	--
Nitrobenzene	10.	ug/L	< 10.	--	--
Isophorone	10.	ug/L	< 10.	--	--
2-Nitrophenol	10.	ug/L	< 10.	--	--
2,4-Dimethylphenol	10.	ug/L	< 10.	--	--
Benzoic Acid	50.	ug/L	< 50.	--	--
bis(2-Chloroethoxy)methane	10.	ug/L	< 10.	--	--
2,4-Dichlorophenol	10.	ug/L	< 10.	--	--
1,2,4-Trichlorobenzene	10.	ug/L	< 10.	--	--
Naphthalene	10.	ug/L	< 10.	--	--
4-Chloroaniline	50.	ug/L	< 50.	--	--
Hexachlorobutadiene	10.	ug/L	< 10.	--	--
4-Chloro-3-methylphenol	20.	ug/L	< 20.	--	--
2-Methylnaphthalene	10.	ug/L	< 10.	--	--
Hexachlorocyclopentadiene	10.	ug/L	< 10.	--	--
2,4,6-Trichlorophenol	10.	ug/L	< 10.	--	--
2,4,5-Trichlorophenol	10.	ug/L	< 10.	--	--
2-Chloronaphthalene	10.	ug/L	< 10.	--	--
2-Nitroaniline	50.	ug/L	< 50.	--	--
Dimethyl phthalate	10.	ug/L	< 10.	--	--
Acenaphthylene	10.	ug/L	< 10.	--	--
2,6-Dinitrotoluene	10.	ug/L	< 10.	--	--
3-Nitroaniline	10.	ug/L	< 10.	--	--
Acenaphthene	10.	ug/L	< 10.	--	--
2,4-Dinitrophenol	50.	ug/L	< 50.	--	--

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

Method: EPA 625
Matrix: Aqueous

GTEL Sample Number	W6030370-01	--	--
Client ID	VCS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:		
4-Nitrophenol	50.	ug/L	< 50.	--	--
Dibenzofuran	10.	ug/L	< 10.	--	--
2,4-Dinitrotoluene	10.	ug/L	< 10.	--	--
Diethyl phthalate	10.	ug/L	< 10.	--	--
4-Chlorophenyl phenyl ether	10.	ug/L	< 10.	--	--
Fluorene	10.	ug/L	< 10.	--	--
4-Nitroaniline	50.	ug/L	< 50.	--	--
4,6-Dinitro-2-methylphenol	50.	ug/L	< 50.	--	--
N-Nitrosodiphenylamine	10.	ug/L	< 10.	--	--
1,2-Diphenylhydrazine	50.	ug/L	< 50.	--	--
4-Bromophenyl phenyl ether	10.	ug/L	< 10.	--	--
Hexachlorobenzene	10.	ug/L	< 10.	--	--
Pentachlorophenol	50.	ug/L	50.	--	--
Phenanthrene	10.	ug/L	< 10.	--	--
Anthracene	10.	ug/L	< 10.	--	--
Carbazole	10.	ug/L	< 10.	--	--
Di-n-butyl phthalate	10.	ug/L	< 10.	--	--
Fluoranthene	10.	ug/L	< 10.	--	--
Benzidine	50.	ug/L	< 50.	--	--
Pyrene	10.	ug/L	< 10.	--	--
Butyl benzyl phthalate	10.	ug/L	< 10.	--	--
3,3'-Dichlorobenzidine	20.	ug/L	< 20.	--	--
Benzo(a)anthracene	10.	ug/L	< 10.	--	--
Chrysene	10.	ug/L	< 10.	--	--
bis(2-Ethylhexyl) phthalate	10.	ug/L	< 10.	--	--
Di-n-octyl phthalate	10.	ug/L	< 10.	--	--
Benzo(b)fluoranthene	10.	ug/L	< 10.	--	--
Benzo(k)fluoranthene	10.	ug/L	< 10.	--	--
Benzo(a)pyrene	10.	ug/L	< 10.	--	--
Indeno(1,2,3-cd)pyrene	10.	ug/L	< 10.	--	--
Dibenz(a,h)anthracene	10.	ug/L	< 10.	--	--
Benzo(g,h,i)perylene	10.	ug/L	< 10.	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 625:

"Test Procedures for Analysis of Organic Pollutants". Code of Federal Regulations. 40CFR Part 136. Appendix A. 1,2-Diphenylhydrazine is quantified as

ANALYTICAL RESULTS
Semivolatile Organics

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

Method: EPA 625
Matrix: Aqueous

GTEL Sample Number	W6030370-01	--	--
Client ID	VCS7	--	--
Date Sampled	03/14/96	--	--
Date Prepared	03/21/96		
Date Analyzed	03/26/96	--	--
Dilution Factor	1.00	--	--

Analyte	Reporting Limit	Units	Concentration:

Notes: (continued)

azobenzene. Sample preparation by liquid/liquid extraction.

W6030370-01:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogate recoveries being outside of acceptability limits due to matrix effects.

W6030370-02:

GC/MS Data indicates the presence of non-target compounds. The reported values should be considered as estimates due to 3 of 6 surrogate recoveries being outside of acceptability limits due to matrix effects.

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Conformance/Non-Conformance Summary

(X = Requirements Met * = See Comments -- = Not Required NA = Not Applicable)

Conformance Item	Volatile Organics	Semi-Volatile Organics	Inorganics (MT, WC)
GC/MS Tune	--	--	NA
Initial Calibration	--	--	--
Continuing Calibration	--	--	--
Surrogate Recovery	--	*	NA
Holding Time	--	X	--
Method Accuracy	--	X	--
Method Precision	--	X	--
Blank Contamination	--	X	--

Comments:

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Surrogate Results

QC Batch No.	Reference	Sample ID	2FP	PHL	NBZ	FBP	TBP	TPH
Method: EPA 625		Acceptability Limits:	21-100%	10- 94%	35-114%	43-116%	10-123%	33-141%
032196BNAW-1	BW032196A1	Method Blank Water	45.4	27.6	55.1	52.6	60.4	64.4
032196BNAW-2	LW032196A1	Laboratory Control	48.4	29.7	66.7	63.8	73.3	58.8
032196BNAW-3	LWD032196A1	LCS Water Duplicat	49.8	31.0	69.7	62.4	80.5	60.8
032196BNAW-4	MS03037203	Matrix Spike	50.3	39.8	61.2	65.4	62.3	58.5
032196BNAW-5	MD03037203	Matrix Spike Dupli	52.0	40.5	62.1	73.8	63.9	63.8
--	03037001	VCS7	39.5	24.0	0.00*	1.73*	51.2	3.30*
--	03037002	SKS7	48.5	37.6	3.19*	2.14*	39.4	3.14*

Notes:

*: Indicates values outside of acceptability limits. See Nonconformance Summary.

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Method Blank Results

QC Batch No: 032196BNAW-1
Date Analyzed: 26-MAR-96

Analyte	Method:EPA 625 Concentration: ug/L
Phenol	< 10.0
bis(2-Chloroethyl) ether	< 10.0
2-Chlorophenol	< 10.0
1,3-Dichlorobenzene	< 10.0
1,4-Dichlorobenzene	< 10.0
1,2-Dichlorobenzene	< 10.0
bis(2-Chloroisopropyl) ether	< 10.0
N-Nitrosodi-n-propylamine	< 10.0
Hexachloroethane	< 10.0
Nitrobenzene	< 10.0
Isophorone	< 10.0
2-Nitrophenol	< 10.0
2,4-Dimethylphenol	< 10.0
bis(2-Chlorethoxy)methane	< 10.0
2,4-Dichlorophenol	< 10.0
1,2,4-Trichlorobenzene	< 10.0
Naphthalene	< 10.0
Hexachlorobutadiene	< 10.0
4-Chloro-3-methylphenol	< 20.0
Hexachlorocyclopentadiene	< 10.0
2,4,6-Trichlorophenol	< 10.0
2-Chloronaphthalene	< 10.0
Dimethyl phthalate	< 10.0
Acenaphthylene	< 10.0
2,6-Dinitrotoluene	< 10.0
Acenaphthene	< 10.0
2,4-Dinitrophenol	< 50.0
4-Nitrophenol	< 50.0
2,4-Dinitrotoluene	< 10.0
Diethyl phthalate	< 10.0
4-Chlorophenyl phenyl ether	< 10.0
Fluorene	< 10.0
4,6-Dinitro-2-methylphenol	< 50.0
N-Nitrosodiphenylamine	< 10.0
4-Bromophenyl phenyl ether	< 10.0
Hexachlorobenzene	< 10.0
Pentachlorophenol	< 50.0
Phenanthrene	< 10.0
Anthracene	< 10.0
Di-n-butyl phthalate	< 10.0
Fluoranthene	< 10.0
Pyrene	< 10.0
Butyl benzyl phthalate	< 10.0
3,3'-Dichlorobenzidine	< 20.0

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Method Blank Results

Benzo[a]anthracene	< 10.0
Chrysene	< 10.0
bis(2-Ethyl hexyl) phthalate	< 10.0
Di-n-octyl phthalate	< 10.0
Benzo[b]fluoranthene	< 10.0
Benzo[k]fluoranthene	< 10.0
Benzo[a]pyrene	< 10.0
Indeno[1,2,3-cd]pyrene	< 10.0
Dibenzo[a,h]anthracene	< 10.0
Benzo[g,h,i]perylene	< 10.0

Notes:

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Matrix Spike(MS) and Matrix Spike Duplicate(MSD) Results

GTEL Sample ID: W6030372-03 MS ID: MS03037203 MSD ID: MD03037203
Analysis Date: 26-MAR-96 26-MAR-96 26-MAR-96

Units: ug/L	Sample	Spikes Added		MS	MS	MSD	MSD		Acceptability Limits	
Analyte	Conc.	MS	MSD	Conc.	% Rec	Conc.	% Rec.	RPD	RPD	%Rec.
Phenol	< 10.0(0.000)	189.	189.	77.7	41.1	79.7	42.2	2.60	42	12-110
2-Chlorophenol	< 10.0(0.000)	189.	189.	118.	62.4	123.	65.1	4.20	40	27-123
1,4-Dichlorobenzene	< 10.0(0.000)	189.	189.	121.	64.0	125.	66.1	3.20	28	36-97
N-Nitrosodi-n-propylamine	< 10.0(0.000)	189.	189.	128.	67.7	148.	78.3	14.5	38	41-116
1,2,4-Trichlorobenzene	< 10.0(0.000)	189.	189.	130.	68.8	123.	65.1	5.50	28	39-98
4-Chloro-3-methylphenol	< 20.0(0.000)	189.	189.	112.	59.3	113.	59.8	0.800	42	23-97
Acenaphthene	< 10.0(0.000)	189.	189.	168.	88.9	170.	89.9	1.10	31	46-118
4-Nitrophenol	< 50.0(0.000)	189.	189.	60.4	32.0	54.9	29.0	9.80	50	10-80
2,4-Dinitrotoluene	< 10.0(0.000)	189.	189.	129.	68.3	133.	70.4	3.00	38	24-96
Pentachlorophenol	< 50.0(0.000)	189.	189.	139.	73.5	132.	69.8	5.20	50	9-103
Pyrene	< 10.0(0.000)	189.	189.	149.	78.8	158.	83.6	5.90	31	26-127

Notes:

Values in parentheses in the sample concentration column are used for % recovery calculations.

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

QUALITY CONTROL RESULTS

Semivolatile Organics
Method: EPA 625
Matrix: Aqueous

Laboratory Control Sample (LCS) and Laboratory Control Duplicate Results

Analyte	Spike Amount	LCS Concentration	LCS Recovery, %	LCS Duplicate Concentration	LCS Duplicate Recovery, %	RPD, %	Acceptability Limits RPD, %	Acceptability Limits Recovery, %
EPA 625 Units: ug/L	QC Batch:032196BNAW-3							
Phenol	100.	35.0	35.0	33.6	33.6	4.08	42	12-110%
2-Chlorophenol	100.	71.9	71.9	67.9	67.9	5.72	40	27-123%
1,4-Dichlorobenzene	100.	59.7	59.7	63.5	63.5	6.17	28	36- 97%
N-Nitrosodi-n-propylamine	100.	79.6	79.6	71.7	71.7	10.4	38	41-116%
1,2,4-Trichlorobenzene	100.	64.3	64.3	68.8	68.8	6.76	28	39- 98%
4-Chloro-3-methylphenol	100.	72.9	72.9	68.8	68.8	5.79	42	23- 97%
Acenaphthene	100.	90.1	90.1	88.9	88.9	1.34	31	46-118%
4-Nitrophenol	100.	33.8	33.8	31.0	31.0	8.64	50	10- 80%
2,4-Dinitrotoluene	100.	75.2	75.2	72.3	72.3	3.93	38	24- 96%
Pentachlorophenol	100.	87.2	87.2	82.8	82.8	5.18	50	9-103%
Pyrene	100.	79.3	79.3	80.6	80.6	1.63	31	26-127%

Notes:

Acceptability limits are derived from USEPA Contract Laboratory Program (CLP) requirements: Statement of Work (SOW) for organic analysis OLM02.0 and OLM02.1.

ANALYTICAL RESULTS
Results For Multiple Methods

GTEL Client ID: CHH02CHH02
Login Number: W6030370
Project ID (number): 107091.EL.96

Method: See Below
Matrix: Aqueous

	GTEL Sample Number	W6030370-01	--	--
	Client ID	VCS7	--	--
	Date Sampled	03/14/96	--	--
EPA 200.7	Date Prepared	03/21/96	--	--
EPA 200.7	Date Analyzed	03/21/96	--	--
EPA 200.7	Dilution Factor	1.00	--	--
EPA 239.2	Date Prepared	03/27/96	--	--
EPA 239.2	Date Analyzed	03/27/96	--	--
EPA 239.2	Dilution Factor	1.00	--	--
EPA 245.1	Date Prepared	03/22/96	--	--
EPA 245.1	Date Analyzed	03/22/96	--	--
EPA 245.1	Dilution Factor	2.00	--	--
EPA 272.2	Date Prepared	03/27/96	--	--
EPA 272.2	Date Analyzed	03/28/96	--	--
EPA 272.2	Dilution Factor	1.00	--	--

Analyte		Reporting Limit	Units	Concentration:		
Inorganics (MT, WC)						
Arsenic	EPA 200.7	400	ug/L	< 400	--	--
Cadmium	EPA 200.7	20.	ug/L	< 20.	--	--
Chromium	EPA 200.7	30.	ug/L	< 30.	--	--
Copper	EPA 200.7	25.	ug/L	< 25.	--	--
Lead	EPA 239.2	4.0	ug/L	< 4.0	--	--
Mercury	EPA 245.1	0.50	ug/L	< 1.0	--	--
Selenium	EPA 200.7	200	ug/L	< 200	--	--
Silver	EPA 272.2	2.0	ug/L	< 2.0	--	--
Zinc	EPA 200.7	20.	ug/L	740	--	--

Notes:

Dilution Factor:

Dilution factor indicates the adjustments made for sample dilution.

EPA 200.7, EPA 239.2, EPA 245.1:

Digestion is method specific.

EPA 200.7, EPA 239.2, EPA 245.1, EPA 272.2:

"Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, USEPA EMSL, Cincinnati, OH, Revised, March 1983.

W6030370-01:

Analyzed for arsenic and selenium by EPA Method 200.7 due to matrix interference on the graphite furnace. Dilutions to overcome these interferences would have raised the reporting limit above that of EPA Method 200.7.

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

QA NONCONFORMANCE SUMMARY

1.0 Sample Handling

1.1 Sample handling and holding time criteria were not met for zero samples.

2.0 Initial Calibration Verification

2.1 The validity for the calibration verification was exceeded for zero samples as shown in Table 2.

3.0 Method Blanks

3.1 Zero target elements were found in the method blank as shown in Table 3.

4.0 Matrix Spike (MS) Accuracy

4.1 The recovery limits were exceeded in the matrix spike and matrix spike duplicate for two elements as shown in Table 4A and Table 4B.

4.2 Recovery limits were exceeded for chromium and zinc in the matrix spike and/or matrix spike duplicate sample(s) due to high concentrations of dissolved solids.

5.0 Sample Duplicate Precision

5.1 The maximum percent difference (RPD) was exceeded for zero elements in the matrix spike and matrix spike duplicate samples as shown in Table 4A and Table 4B.

6.0 Laboratory Control Sample

6.1 The recovery limits were not met for zero elements for the laboratory control samples as shown in Table 5.

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 2

INITIAL CALIBRATION VERIFICATION QC CHECK SAMPLE REPORT

Metals in Water[a]

Analyte	Expected Result, ug/L	Observed Result, ug/L	Recovery, %	Acceptability Limits, %[a]
Arsenic	1000	972	97.2	95-105
Cadmium	1000	981	98.1	95-105
Chromium	996	988	99.2	95-105
Copper	1000	987	98.7	95-105
Lead	20.0	21.6	106	90-110
Mercury	4.00	4.03	101	90-110
Selenium	1000	970	97.0	95-105
Silver	2.00	1.98	99.0	90-110
Zinc	1000	998	99.8	95-105

a Acceptability limits as per EPA Contract Laboratory Program

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 3

BLANK REPORT

Metals in Water

Analyte	Initial Calibration Blank, ug/L	Preparation Blank, ug/L
Arsenic	<400	<400
Cadmium	<20	<20
Chromium	<30	<30
Copper	<25	<25
Lead	<4.0	<4.0
Mercury	<1.0	<1.0
Selenium	<200	<200
Silver	<2.0	<2.0
Zinc	<20	<20

<# Not detected at the indicated detection limit (#)

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 4A

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

Metals in Water

Sample Spiked: Method 239.2 and 272.2 - W6-03-0365-03
Sample Spiked: Method 245.1 - W6-03-0370-01
Sample Spiked: Method 200.7 - W6-03-0364-02

Analyte	Spike Added, ug/L	Sample Concentration, ug/L	MS Concentration, ug/L	MS Percent Recovery	Acceptability Limits, %[a]
Arsenic	2000	<400	1760	88.3	80-120
Cadmium	1000	<20.0	831	83.1	80-120
Chromium	400	<30.0	301	75.2[b]	80-120
Copper	400	<25.0	340	85.1	80-120
Lead	20.0	6.40	26.2	99.0	75-125
Mercury	2.00	<1.00	1.67	83.5	75-125
Selenium	1990	<200	1760	88.1	80-120
Silver	2.50	<1.00	2.63	105	80-120
Zinc	2000	<20.0	1600	80.0	75-125

a Acceptability limits as per EPA Contract Laboratory Program.

b Value outside acceptability limits.

NA Not applicable; initital sample concentration greater than four times spike amount.

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 4B

MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

Metals in Water

Analyte	Spike Added, ug/L	MSD Concentration, ug/L	MSD Percent Recovery	RPD %	Acceptability Limits, %[a]	
					RPD	% Recovery
Arsenic	2000	1670	83.3	5.74	20.0	80-120
Cadmium	1000	807	80.7	2.87	20.0	80-120
Chromium	400	296	73.9[b]	1.74	20.0	80-120
Copper	400	327	81.8	4.01	20.0	75-125
Lead	20.0	26.5	100	1.50	20.0	75-125
Mercury	2.00	1.52	76.0	9.40	20.0	80-120
Selenium	1990	1680	84.4	4.33	20.0	80-120
Silver	2.50	2.39	95.6	9.37	20.0	75-125
Zinc	2000	1540	77.2[b]	3.32	20.0	80-120

a Acceptability limits as per EPA Contract Laboratory Program.

b Value outside acceptability limits.

NA Not applicable; inititial sample concentration greater than four times spike amount.

Table 5

LABORATORY CONTROL SAMPLE RESULTS

Metals in Water

Analyte	Expected Result, ug/L	Observed Result, ug/L	Recovery, %	Acceptability Limits, %[a]
Arsenic	2000	2040	102	80-120
Cadmium	1000	1010	101	80-120
Chromium	400	417	104	80-120
Copper	400	418	104	80-120
Lead	20.0	21.9	110	75-125
Mercury	2.00	1.71	85.5	75-125
Selenium	1990	1980	99.2	80-120
Silver	2.50	2.24	89.6	75-125
Zinc	2000	2050	102	80-120

a Acceptability limits established by laboratory practice

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

ANALYTICAL RESULTS

Inorganics

GTEL Sample Number			01	02		
Client Identification			VCS7	SKS7		
Date Sampled			03-14-96	03-14-96		
Date Analyzed			03-22-96	03-22-96		
Analyte	Method	QL* & Units	Concentration			
Total Recoverable Phenols	EPA 420.1	0.01 mg/L	**0.17**	**0.51**		

a Distillation by 350.2.

* Quantitation Limit

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

QA NONCONFORMANCE SUMMARY

Inorganics

1.0 Sample Handling

1.1 Sample handling and holding time criteria were not met for **0** samples.

2.0 Initial Calibration Verification

2.1 The criteria for the calibration verification QC Check Sample was exceeded for **0** samples as shown in Table 2.

3.0 Method Blanks

3.1 **Zero** target analytes were found in the method blank as shown in Table 3.

4.0 Matrix Spike (MS) Accuracy

4.1 The recovery limits were exceeded in the matrix spike for **0** analyte as shown in Table 4.

5.0 Sample Duplicate Precision

5.1 The maximum percent difference (RPD) was exceeded for **0** analytes in the duplicate samples as shown in Table 5.

6.0 Laboratory Control Sample

6.1 The recovery limits were not met for 0 analytes in the Laboratory Control Sample as shown in Table 6.

Project ID (Number): CHH02.CHH02

Work Order Number: W6-03-0370
Date Reported: 03-29-96

Table 2

INITIAL CALIBRATION VERIFICATION QC CHECK SAMPLE REPORT

Inorganics

Analyte	Expected Result	Observed Result	Units	Recovery, %	Acceptability Limits, %[a]
Total Recoverable Phenols	0.010	0.0103	mg/L	103	90-110
					90-110

a Acceptability limits established by laboratory practice.

Table 3

BLANK REPORT

Inorganics

Analyte	Initial Calibration Blank	Preparation Blank	Units
Total Recoverable Phenols	<0.01	<0.01	mg/L

Table 4

MATRIX SPIKE (MS) RECOVERY SUMMARY

Inorganics

Sample Spiked: W6-03-0346-01

Analyte	MS Sample Result	Sample Result	Amount Added	Units	MS, % Recovery	Acceptability Limits, %[a]
Total Recoverable Phenols	0.0376	<0.01	0.04	mg/L	93.9	80-120

a Acceptability limits established by laboratory practice.

Table 5

LABORATORY DUPLICATE SAMPLE RESULTS
AND RELATIVE PERCENT DIFFERENCE (RPD) SUMMARY

Inorganics

Analyte	Matrix Spike Result	Matrix Spike Duplicate Result	Units	RPD, %	Maximum RPD, %[a]
Total Recoverable Phenols	0.0376	0.0375	mg/L	0.079	20

a Acceptability limits established by laboratory practice.

Table 6

LABORATORY CONTROL SAMPLE RESULTS

Inorganics

Analyte	Expected Result	Observed Result	Units	Recovery, %	Acceptability Limits, %[a]
Total Recoverable Phenols	0.04	0.037	mg/L	92.4	80-120

a Acceptability limits established by laboratory practice

Copy to Dave Sinclair
Pat Young has tapes

Engineers
Planners
Economists
Scientists

MAY 2 1996

29 April 1995

107091.RS.R2 (PDX30702)

Patricia N.N. Young
American Samoa Program Manager
Office of Pacific Islands
and Native American Programs
U.S. Environmental Protection Agency
75 Hawthorne Street (E-4)
San Francisco, California 94105

Sheila Wiegman
American Samoa Environmental
Protection Agency
American Samoa Government
Pago Pago, American Samoa 96799

Dear Pat:
Dear Sheila:

Subject: Joint Cannery Outfall:
March 1995 Coral Reef Survey Report and Tapes

Enclosed are two copies of the final report for the second Coral Reef Survey conducted in March 1995 in Pago Pago Harbor. The next study is planned for February/March 1997 and will be carried in a manner consistent with the previous studies. Please let me know if you have any comments on concerns on the conduct or reporting of this or previous studies.

The reef survey indicated no observable effect of cannery discharge on the overall health of the coral reef system in the harbor. There was an indication of possible improvements in the inner harbor (Station IH5). The effluent plume is trapped well below the reef survey area which extends to 60 feet and does not directly affect the reef area. The station closest to the discharge (OH5) shows more coral coverage and diversity in 1995 compared to the 1991 and 1993 observations. This indicates no adverse impact of the relocation of the outfall. Observations at the middle harbor and outer harbor stations in general indicate variability but no overall trend in hard coral coverage.

CH2M HILL 1111 Broadway, P.O. Box 12681, Oakland, CA 94604-2681 510 251-2426 Fax 510 893-8205

Also enclosed with this letter is one set of copies the video tapes from the March 1995 studies. If you have any questions or comments please call me at your convenience.

Sincerely,

CH2M HILL

Steven L. Costa, Project Manager

enc: 2 copies of March 1995 coral reef survey study report
1 copy of underwater video for all transects (3 VHS tapes)

cc: Norman-Wei, StarKist Seafood Co. with 1 copy of report and video tapes
James Cox, Van Camp Seafood Co. with 1 copy of report and video tapes
Barry Mills, StarKist Samoa with 1 copy of report
Bill Perez, VCS Samoa Packing with 1 copy of report
David Wilson, CH2M HILL/SEA with 1 copy of report and original tapes
Tom Coyner, Sound Analytical with one copy of report
Troy Buckley

MEMORANDUM

CH2MHILL

Log for Video Tapes

TO: Recipients of Coral Reef Survey Report

FROM: Steve Costa/CH2M HILL

DATE: 29 April 1996

The tapes accompanying the Coral Reef Survey Report do not have transects identified. A log for these tapes will be sent under separate cover.

Rcd 5/13/96

MEMORANDUM CH2MHILL

Log for March 1995 Coral Reef Survey Videos

TO: Pat Young/USEPA
Sheila Wiegman/ASEPA
Norman Wei/StarKist
Jim Cox/Van Camp

COPIES: File
David Wilson/SEA

FROM: Steve Costa/CH2M HILL

DATE: 9 May 1996

The table below identifies the order of survey stations shown on the VHS tapes previously sent to you. Unless otherwise indicated all survey stations were done from deep to shallow; the deepest transect was done first and the shallowest done last at each station.

Tape No.	Sequence	Station	Date of Survey	Time	Comments
1	1	MH-1	21 March 95	14:00	
	2	MH-3	21 March 95	15:10	25 then 40 foot depths
	3	MH-3	21 March 95	16:00	Reef Top
	4	OH-2	23 March 95	11:35	
	5	OH-3	23 March 95	12:45	
	6	MH-6	23 March 95	15:00	25, 40, then 55 foot depths
	7	IH-3	23 March 95	16:10	
Tape No.	**Sequence**	**Station**	**Date of Survey**	**Time**	**Comments**
2	1	MH-8	24 March 95	12:50	
	2	MH-8	24 March 95	13:10	Reef Top
	3	MH-7	24 March 95	14:00	at 20-30 feet (extra footage)
	4	IH-4	27 March 95	15:15	
	5	OH-1	27 March 95	11:10	
	6	OH-5	27 March 95	12:10	
	7	MH-7	27 March 95	15:00	
	8	MH-5	27 March 95	16:20	

Tape No.	Sequence	Station	Date of Survey	Time	Comments
3	1	IH-5	28 March 95	13:55	
	2	MH-2	28 March 95	14:55	
	3	MH-4	28 March 95	15:55	
	4	MH-4	28 March 95	16:20	Reef Top
	5	S-3	28 March 95	17:00	10 to 60 feet
	6	OH-4	29 March 95	09:15	
	7	OH-4	29 March 95	10:00	Reef Top
	8	S-2	29 March 95	11:30	10 to 60 feet
	8	S-1	29 March 95	11:45	Visibility poor (1-5 feet)

JOINT CANNERY OUTFALL CORAL REEF SURVEY REPORT
March 1995 Survey

NPDES Permits AS0000019 & AS0000027

StarKist Samoa, Inc. and
VCS Samoa Packing Company
Pago Pago, American Samoa

April 1996

Prepared By
CH2M HILL

JOINT CANNERY OUTFALL CORAL REEF SURVEY REPORT
March 1995 Survey

NPDES Permits AS0000019 & AS0000027

StarKist Samoa, Inc. and
VCS Samoa Packing Company
Pago Pago, American Samoa

April 1996

Prepared By
CH2M HILL

EXECUTIVE SUMMARY

The second of the required biannual coral reef surveys has been conducted in Pago Pago Harbor in fulfillment of NPDES permit conditions. The survey was conducted during March 1995. A total of 19 locations throughout the harbor were surveyed as follows:

- Twelve transects at six locations in the inner harbor
- Twenty six transects at eight locations in the middle harbor
- Fifteen transects at five locations in the outer harbor

The required series of coral reef surveys is designed to provide data needed to evaluate potential impacts of treated wastewater discharge from the Joint Cannery Outfall on the nearby coral reef. The coral reef surveys provide information needed to evaluate and detect significant differences, if any, from an earlier study done in January of 1991. The survey sites and data collected in March 1995 were consistent with the 1991 study, and the previous results of the 1993 survey conducted under the NPDES permits.

The survey was done by making video recordings of transects at multiple depths at each site. The video recordings were then analyzed and summarized by a qualified marine ecologist with expertise in coral reef taxonomy and previous experience in American Samoa. The survey data are presented in terms of estimated hard coral coverage and the number of hard coral species identified for each transect.

Prior to February of 1992 the discharges from the canneries were through two short outfalls in the inner harbor. The discharge point for the canneries was relocated to the outer harbor using a joint outfall. In addition, the canneries instituted high strength waste segregation, using an EPA approved ocean disposal site for the high strength wastes, in August of 1990. Comparison of the survey data for the inner harbor indicate no change in conditions (or possibly a slight improvement) between the 1991, 1993 and 1995 surveys. One of outer harbor the survey transects is located approximately 600 feet from the new outfall location. No evidence of wastewater impacts or settleable solids was observed at this station. A potential improvement in coral growth has been observed at this station.

Any impacts to coral reef communities due to high strength waste segregation or outfall relocation are expected to be long term and difficult to distinguish from variability due to other factors. The results from the first two coral reef surveys support this expectation. No observable apparent trends in reef coral communities or effects of changes in cannery discharge are immediately obvious based on the available data. This is not unanticipated. Changes in the inner harbor are expected to be long term. Since the discharge plume in the outer harbor is trapped deeper than 60 feet most, if not all, of the time, no impact from the relocated discharge is expected in the middle or outer harbor. Additional surveys may provide sufficient information to statistically assess natural variability and variability induced by survey methodology and techniques. This may provide a better data base to evaluate potential impacts of the changes in cannery discharge practices. The next survey is scheduled for February/March 1997.

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Section 1

INTRODUCTION

This report presents the field survey results of coral reef surveys in the inner, middle, and outer regions of Pago Pago Harbor, American Samoa. The survey was conducted March 21-29, 1995 and is the second of a series of required surveys. The survey is intended to provide information for comparison with past and future surveys. This work has been conducted to comply with conditions of the United States Environmental Protection Agency (EPA) NPDES Permit No. AS0000019 for Star-Kist Samoa Inc. and NPDES Permit No. AS0000027 for VCS Samoa Packing Company, Inc. The coral reef surveys are required under Section I of the NPDES permits, which state the following:

> *"Within six months of the effective date of this NPDES permit, the permittee, in cooperation with {Samoa Packing Co.; Star-Kist Samoa}, shall submit a field study design for approval by ASEPA and EPA Region 9 to assess the potential impacts of the discharge on the nearby coral reef. The study shall include coral reef transects which shall conform to locations found on Figure 4 in the USE ATTAINABILITY AND SITE-SPECIFIC CRITERIA ANALYSES; PAGO PAGO HARBOR, AMERICAN SAMOA, FINAL REPORT (CH2M HILL, March 15, 1991). The intent of this annual survey is to detect significant differences, if any, from the database information found in the above-cited document. Videos shall be submitted to both the USEPA and ASEPA. Guidance for designing such surveys is provided in the Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters November 1982, EPA #430/0-82-010 (pages 70-71). In addition, the discharger should consult Ecological Impacts of Sewage Discharges on Coral Reef Communities, September 1983, EPA #430/9-83-010, for further information. The study shall be conducted within one year of the effective date of this permit and every two years thereafter."*

A Coral Reef Survey Study Plan was submitted for review and approval to the EPA and ASEPA on January 8, 1993. The study plan was designed, to the extent possible, to be consistent with a previous study done by CH2M HILL in January 1991 as referenced above in the permit condition. During the development and review of the Coral Reef Survey Study Plan, comments received from USEPA and ASEPA were reviewed and incorporated into the study plan, as necessary. The study plan, the comments on the study plan, and the response comments on the study plan were included in the study report for the February 1993 reef survey (CH2M HILL, 1993).

The first required study under the NPDES permit was conducted in February 1993 and reviewed by USEPA and ASEPA. One comment was received on the 1993 study, which is discussed in the description of study approach below. During the 1995 study no substantial recommended changes to the study plan were identified for future surveys, although

CH2M HILL does recommend that positioning be done using an appropriate global positioning system (GPS) rather than a MiniRanger system.

BACKGROUND

The NPDES permit condition states that coral reef surveys shall be conducted at all of the same sites surveyed during the 1991 *Use Attainability Analysis* (CH2M HILL, 1991) to detect significant differences, if any, from the 1991 baseline reef survey data. The wastewater discharge locations and methods for the canneries have changed between the 1991 survey and the initiation of surveys required under the NPDES permit condition. This has had an effect on receiving water conditions throughout the harbor.

In January 1991, when the previous (baseline) reef survey study was conducted, the two canneries operated separate wastewater outfalls in the inner harbor area of Pago Pago Harbor. Currently, Star-Kist Samoa and Samoa Packing operate a joint wastewater outfall that extends over 7,000 feet west from the canneries to a deep-water site offshore of Anasosopo Point in the outer harbor. The outfall consists of a 16-inch HDPE pipe that terminates with a multiport diffuser at a depth of 176 feet below mean lower low water (MLLW). The outfall pipeline route and diffuser location are shown in Figure 1-1. In addition to relocating the discharge in February of 1992, the canneries began high strength waste segregation in August of 1990. Since that time cooker juice, press liquor, and cannery sludge have been disposed of at an EPA-approved ocean disposal site.

The January 1991, February 1993 ,and March 1995 surveys, involved recording reef transects at multiple-depths along the reef fronts at 19 sites located around the entire circumference of Pago Pago Harbor. The 1991 and 1993 coral reef field surveys were designed to provide comparable records of the reef conditions around the entire harbor for use in an evaluation of reef-face habitat conditions in areas of the inner, middle, and outer Pago Pago harbor. These surveys were designed to provide a semi-quantitative summary of reef corals and other benthic species, and reef fish identifications were incidental.

APPROACH

The approach and methodology for the coral reef survey has been designed to the extent feasible to maintain consistency between the periodic studies, and to be consistent with available guidance provided in the *Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters* (USEPA, November, 1982). To meet the NPDES permit conditions, video transects were recorded at multiple depths at each of the nineteen established reef transect sites around Pago Pago Harbor (Figure 1-2).

The coral reef field surveys were conducted to provide video transect records of the reef conditions around Pago Pago Harbor that can be compared with the 1991 and 1993 surveys and

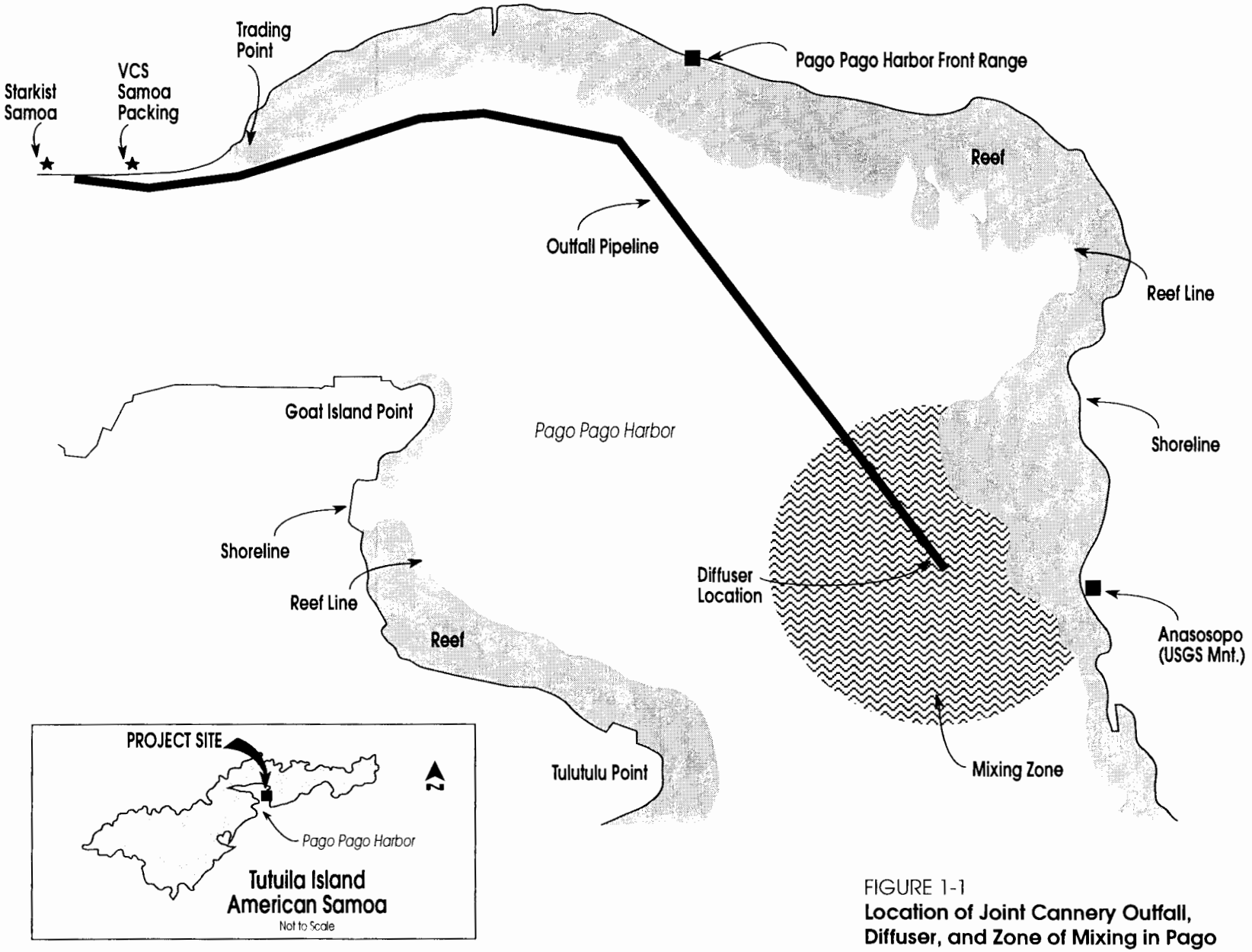

FIGURE 1-1
Location of Joint Cannery Outfall, Diffuser, and Zone of Mixing in Pago Pago Harbor

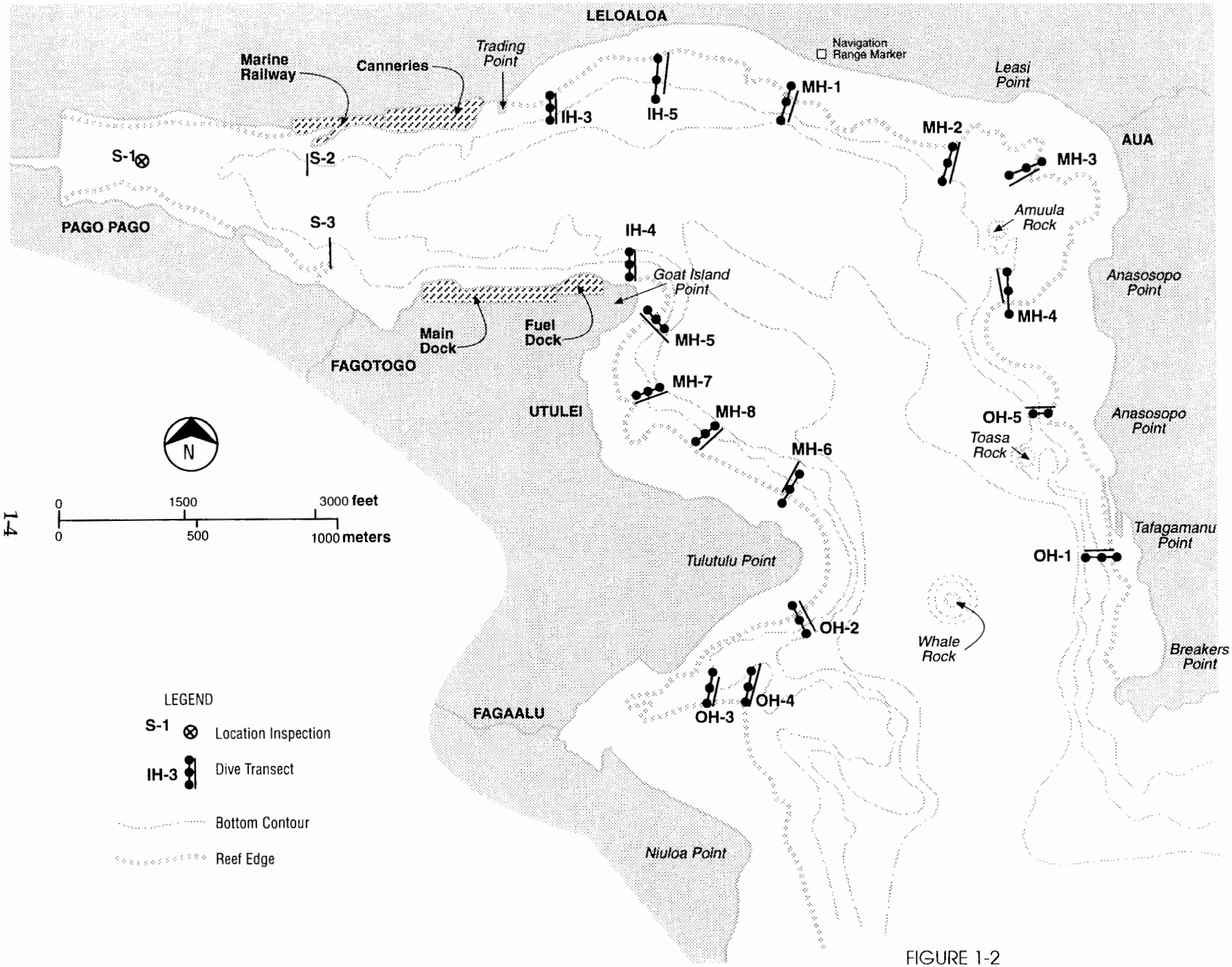

FIGURE 1-2
Location of Coral Reef Transects in Pago Pago Harbor

with future surveys at the same locations. These surveys can be used to evaluate the condition of and changes to the reef-face habitat in areas of the inner, middle, and outer Pago Pago harbor. The surveys are limited to providing semi-quantitative data on the type and percent cover of live reef corals and other benthic species. Reef fish identifications are incidental to the reef habitat evaluation.

Review of the 1991 survey report by USEPA and ASEPA resulted in one comment from USEPA (1994) which stated, "If any quantitative analysis is desired, random quadrat photos along the transects would be a more appropriate means of detecting temporal changes in the community." This is similar to comment number 8 on the study plan as provided in the 1993 survey report (CH2M HILL, 1993) . The intent of the study is to monitor long term overall changes in the various portions of the harbor. Since video records at the start and end of the transect locations are at fixed points, and additionally the video transect record includes scale by including the tape measure placed on the bottom, both fixed and random locations of known area can be derived from the video record if desired. However, our analysis is intended to be a monitoring or screening level exercise to detect the onset of significant changes in the harbor. If such changes are detected, and are considered potential adverse impacts, additional work may be required to assess the significance and causes of such changes.

The video transect records were analyzed and summarized by Mr. Troy Buckley of the University of Washington School of Fisheries. Mr. Buckley is a qualified marine ecologist with knowledge of tropical reef taxonomy and several years of site specific experience in American Samoa. He also analyzed the 1991 and 1993 survey videos. Estimates were developed of live coral coverage and specific benthic genera identifications were provided, as feasible, from the video record. Field survey data are presented in tabular formats in the results section of this report. Supporting data are included in the report appendix. Copies of the video records are provided to ASEPA and USEPA as separate attachments to this report.

STUDY SITE DESCRIPTION

The *American Samoa Coral Reef Inventory* (published by the U.S. Army Corps of Engineers in 1981), reports that the fringing coral reefs in Pago Pago Harbor have been extensively modified, primarily by the U.S. Navy and American Samoan Government. Dredging, filling, construction of rock seawall and other structures for roadway slope stabilization, and other construction activities have resulted in physical alterations to the coral reefs. These activities began around 1900. The most dramatic changes occurred during World War II and since 1960. The Coral Reef Inventory reports that approximately 23-percent of the original reef flat area in Pago Pago Harbor has been filled.

The inner harbor area has been the most affected by development activities. According to the Coral Reef Inventory, 95 percent of the original reef in the Inner Harbor has been converted to dry land. Some remnant reef is found in the Inner Harbor area but living corals have been

absent from the Inner Harbor for many years. This conclusion, presented in the Coral Reef Inventory, was drawn from a 1977 study.

Substantial physical alterations to the reef in the Middle and Outer Harbor include the following as presented in the Coral Reef Inventory:

- The reef flat off the Rainmaker Hotel and Utulei Beach has been dredged to provide sandy areas for swimming and access across the reef.
- Near Aua Point, a borrow pit 18 feet deep was dredged to obtain roadbed fill material, creating a large lagoon inside the inner reef.
- The shoreline north of Tafagamanu Point was extended 300 feet onto the reef flat by filling for a sanitary landfill.
- An extensive fill area along the south Fagaalu Bay was developed for a public park from material dredged from the reef flat.
- The discharge of sediments from the streams draining into the harbor has led to extensive siltation over large portions of the reef near the mouths of these streams (described in detail below).

The coral reefs of Samoa have been subjected to periodic infestations or population explosions of the coral-feeding crown-of-thorns starfish (*Acanthaster planci*). The 1981 Coral Reef Inventory reports serious crown-of-thorns infestations on the reefs of Tutuila Island in the 1920s and most recently in the late 1970s and early 1980s. These periodic infestations have greatly reduced the live coral assemblages on the fringing reefs. Destruction of the live coral assemblages has been shown to vary widely, but, as described in the Coral Reef Inventory, roughly 50 to 95 percent of live coral were estimated to have been destroyed by the 1970-80 starfish infestation.

Recent dive surveys of the coral reefs in the Fagatele Bay Marine Sanctuary have shown live coral coverages of approximately 50 percent after nearly complete destruction by the crown-of-thorns starfish. The fringing reefs of middle and outer Pago Pago Harbor were also substantially damaged by the crown-of-thorns infestation. The starfish were observed on the reefs off Aua (in middle harbor) and of Fagaalu (outer harbor) during 1980 when the Coral Reef Inventory was conducted. Reef recovery from these infestations is slow, and the existing live coral coverages on the fringing reefs of Tutuila Island still show large areas of dead coral.

Periodic hurricanes pass near or directly over Tutuila Island, and these storms generate large waves. Waves approaching from the south enter the outer and middle harbor and break on fringing reef, damaging the reef habitat either directly or by disturbing sediments that are deposited on the reefs. Recent intense hurricanes, particularly Hurricane Fay, have had significant impacts on the fringing reefs in Pago Pago Harbor through wave impacts, siltation, and longline vessels grounded on the reefs. In addition, much of the road bed abutting the reef flat is unprotected from erosion through riprap cover or other stabilization techniques, leading

to extensive siltation of some areas of the reef flats. In recent years erosion protection along portions of the roadway has been improved.

Potential impacts from cannery, and other point source, discharges include direct sedimentation on the reef and reduced water clarity because of sediments and high algal productivity resulting from nutrient inputs. Affects on coral reef communities appear to have been substantially eliminated with the implementation of high strength waste stream segregation and the relocation of the outfall diffuser to water depths of more than 170 feet in the outer harbor.

Dye studies conducted by CH2M HILL (1992, 1993) as a condition of the NPDES permit indicate that the plume typically remains trapped in the lower part of the water column. Under certain meteorological and oceanographic conditions the plume rises further but is typically diluted to more than 2000:1 it the edge of the permitted mixing zone and does not impact the nearby coral reefs.

Harbor water quality monitoring, also done as a condition of the NPDES permit indicates that nutrient levels have fallen below the American Samoa water quality standards (ASWQS) and phytoplankton levels have similarly fallen (CH2M HILL, 1995). The same study has indicated that light penetration also meets the ASWQS.

Section 2

FIELD SURVEY METHODS

This section describes the methods and equipment used for the coral reef surveys, including horizontal positioning at each reef site, sampling methods, and QA/QC procedures. Field equipment requirements for the reef surveys are listed in Table 2-1. A small work vessel was used for the surveys. A three-person staff was aboard to conduct the reef survey transects.

Table 2-1
Field Equipment for Coral Reef Surveys

Equipment Item	Purpose	Number of Units
Work Vessel	Field Sampling Platform	1
SCUBA diving equipment and tanks	Underwater surveys	3
ScubaPro Monitor II Dive Computer	Continuous dive logging for each diver's repetitive dives and surface intervals (safety equipment)	2
Sony 8mm Videocamera w/ underwater housing and lights	Underwater videotaping of reef transects	2
Sony 8mm Videotape player	Viewing and verification of videotape records	1
Nikonos Camera	Underwater still photographs	1
100 feet fiberglass tape measure	Provide reference line for video transects	1
Transect Stakes	Re-establish start and end point for any missing stakes	20
Depth Gage	Verify transect depths	2
Trimble GPS System	Global Positioning System for Backup and field trial in Pago Pago Harbor	1
Motorola Mini-Ranger III System	Microwave positioning System with 3 shore-based transponders	1

SURVEY SITES AND FIELD POSITIONING

Nineteen reef sites were surveyed as shown on Figure 1-2. Transects were conducted at multiple depths at 16 of these sites. Only a single transect was conducted from the top to the base of the reef at the three sites located in the western end of the inner harbor (S-1, S-2, and S-3 on Figure 1-2). The nineteen reef survey sites were located based on the descriptions in the 1991 Use Attainability Analysis reef survey logbook and photographs of the reef and shoreline at each site. The horizontal position of each site was established in February 1993 using a Motorola Mini-Ranger III electronic positioning system. The Mini-Ranger III provides positioning range accuracy of approximately ±2 meters. The previously established Mini-Ranger locations of each site and the site descriptions are given in Table 2-2 for the inner harbor, Table 2-3 for the middle harbor, and Table 2-4 for the outer harbor.

Except as discussed below, each of the nineteen sites was relocated by means of the transect marker stakes placed in 1993 the start of each transect. Transect marker stakes were relocated by visual positioning, the Mini-Ranger coordinates, and/or GPS positioning. A buoy was be deployed to assist divers to search for the stakes when not immediately recovered.

Markers for some of the transects in high wave energy locations in the outer harbor were not recovered. These locations have a lot of rubble material and still may be readjusting from the huricanne damage as discussed in the previous coral reef survey report. These locations were re-marked with new stakes and relocated using the GPS system (see Table 2-4). The re-marked locations are as folows:

- OH-1: All three stakes (at 25, 40, and 60 feet) were re-installed. The original stake at the 40-foot depth was found during installation of the new stakes.
- OH-2: All three stakes (at 25, 40, and 60 feet) were reinstalled at appoximate locations of original transects.
- OH-5: All three stakes (at 25, 40, and 60 feet) were reinstalled at appoximate locations of original transects.

REEF TRANSECT METHODS

Marine biologist-divers recorded underwater video transects on the reef front at 19 sites in Pago Pago Harbor (Figure 1-2). At 16 sites (IH-3, 4, 5, MH-1 through 8, and OH-1 through 5), video transects were recorded along the reef face at three depths. The three sites located in the western end of the inner harbor (S-1, S-2, and S-3) are remnants of reefs with less than 5 percent live coral, and only a single transect was recorded from the reef flat down to the base of the reef face.

Each video transect, with the exceptions mentioned above, was conducted parallel with the reef face (along a depth contour) along a 30-meter fixed transect line on the reef. The depths at which video transects were recorded included: the reef edge (15- to 20-foot depth), on the reef face (at 30- to 40-foot depth), and near the base of the reef face (at 55- to 65-foot depth). The reef front at some sites (e.g. MH-3) does not extend below 45 feet, and only two transects were be conducted at such sites. Video records of the reef flat areas were also recorded at six representative sites (IH-3, MH-3, MH-8, OH-3, and OH-5) to document reef flat conditions.

Table 2-2
Inner Harbor Transect Locations for Coral Reef Survey Pago Pago Harbor
Established During February 1993 Survey

Station	Sampling Location and Depth (feet)	Navigation Coordinates for MiniRanger System (a,b)	
		Code 1	Code 4
S-1	Inner Harbor, approx. 1,000 feet east of mouth of Pago Pago Stream, at 20- to 50-foot depth	2468 (N)	1584 (N)
S-2	Inner Harbor, immediately in front of Marine Railway facility, at 15- to 50-foot depth	1833 (N)	1050 (N)
S-3	Inner Harbor, in front of Marine Resources Building at Fagotogo, at 10- to 65-foot depth	1899 (N)	783 (N)
IH-3	Inner Harbor, approx. 200 feet east of Trading Point, Transects at 25, 40, and 60 feet	1033 (N)	833 (N)
IH-4	Inner Harbor, located on north side of Goat Island Point, Transects at 25, 40, and 60 feet	1016 (N)	383 (N)
IH-5	Inner Harbor, located off Leloaloa and 1,600 feet east of Trading Point, Transects at 20 and 35 feet	601 (N)	1085 (N)

NOTES:

(a) The shore-based Mini-Ranger transponders were located at survey control points as follows: Code 1 - located at Pago Pago Harbor Front Range Tower (261,551.58E and 309,857.04N, State Coordinates (feet)); Code 4 - located at Fagatogo Tram Park Building (258,117.06E and 305,879.24N, State Coordinates (feet)).

(b) The navigation readings are designated as either north (N) or south (S) of the alignment between the Code 1 and Code 4 shore transponder stations. NR indicates no readings were recorded due to the transponder station being obstructed.

Table 2-3
Middle Harbor Transect Locations for Coral Reef Survey Pago Pago Harbor
Established During February 1993 Survey

Station	Sampling Location and Depth (feet)	Navigation Coordinates for MiniRanger System (a,b)	
		Code 1	Code 4
MH-1	Middle Harbor, located off Harbor front range marker (Code 1), Transects at 25, 40, and 60 feet	216 (S)	1198 (S)
MH-2	Middle Harbor, located off Leasi Point, Transects at 25, 40, and 60 feet	533 (S)	1582 (S)
MH-3	Middle Harbor, located west of Aua and north of Amuula Rock, Transects at 20 and 35 feet	750 (S)	1798 (S)
MH-4	Middle Harbor, located on north face of reef and west of Aua Point, Transects at 25, 40, and 60 feet	1082 (S)	1649 (S)
MH-5	Middle Harbor, located on south face of reef at Goat Island Point, Transects at 25, 40, and 60 feet	1116 (S)	400 (S)
MH-6	Middle Harbor, located on northeast face of reef off Tulutulu Point, Transects at 25, 40, and 60 feet	1550 (S)	1052 (S)
MH-7	Middle Harbor, located on east face of reef off Utulei, Transects at 25, 40, and 60 feet	1349 (S)	399 (S)
MH-8	Middle Harbor, located on east face of reef off Utulei tank farm, Transects at 25, 40, and 60 feet	1449 (S)	683 (S)

NOTES:

(a) The shore-based Mini-Ranger transponders were located at survey control points as follows: Code 1 - located at Pago Pago Harbor Front Range Tower (261,551.58E and 309,857.04N, State Coordinates (feet)); Code 4 - located at Fagatogo Tram Park Building (258,117.06E and 305,879.24N, State Coordinates (feet)).

(b) The navigation readings are designated as either north (N) or south (S) of the alignment between the Code 1 and Code 4 shore transponder stations. NR indicates no readings were recorded due to the transponder station being obstructed.

One diver maintained position at the starting transect stake location and handled a 100-foot tape measure (also marked in meters). The other diver swam slowly along the established 30-meter transect line with the video camera and recorded two passes on the line. At the coompletion of the transect filming, the transect line was picked up and moved to the next transect depth and the procedure was repeated.

Table 2-4
Outer Harbor Transect Locations for Coral Reef Survey Pago Pago Harbor
Established During February 1993 Survey
{Indicated Transects Re-established During March 1995 Survey}

Station	Sampling Location and Depth (feet)	Navigation Coordinates for MiniRanger System (a,b)	
		Code 1	Code 4
OH-1	Outer Harbor, located on west face of reef off Tafagamanu Point, Transects at 25, 40, and 60 feet	2033 (S) *{1954 (S)}*	2166 (S) *{2154 (S)}*
OH-2	Outer Harbor, located on south face of reef south of Tulutulu Point, Transects at 25, 40, and 60 feet *{GPS: Lat= 14°17'25.701''S; Long= 170°0' 29.779''W}*	2016 (S)	NR
OH-3	Outer Harbor, located on north face of reef, north of Niuloa Point, Transects at 25 and 40 feet {Landnark/bearings used to locate transect}	NR	NR
OH-4	Outer Harbor, located on north face of reef, north of Niuloa Point, Transects at 25, 40, and 55 feet {GPS: Lat= 14°17'32.632''S; Long= 170°40'36.233''W}	NR	NR
OH-5	Outer Harbor, located on west face of reef off Anasosopo Point, Transects at 25, 40, and 60 feet	1466 (S) *{1646 (S)}*	1799 (S) *{1992(S)}*

NOTES:
(a) The shore-based Mini-Ranger transponders were located at survey control points as follows: Code 1 - located at Pago Pago Harbor Front Range Tower (261,551.58E and 309,857.04N, State Coordinates (feet)); Code 4 - located at Fagatogo Tram Park Building (258,117.06E and 305,879.24N, State Coordinates (feet)).
(b) The navigation readings are designated as either north (N) or south (S) of the alignment between the Code 1 and Code 4 shore transponder stations. NR indicates no readings were recorded due to the transponder station being obstructed.

A field logbook was maintained and included: the sampling times, descriptions of the site, transect depths, reef face structure and features, reef biota observations, and weather and sea conditions. The videotape was reviewed at the completion of each day in the field to ensure that the record is complete and to record the location of each transect record on the video tape.

QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance and quality control objectives for the coral reef surveys are to record representative reef-front transects at each site and provide scientific interpretations and summaries of these reef transect videos that are of known and acceptable quality. The following requirements were instituted for the filed data collection to meet the objectives.

- Establish long-term transect markers and document survey site positions (within 2 meters) for repeat surveys.
- Provide field equipment redundancy (backup equipment).
- Develop a field operations and safety plan for conducting the reef surveys to summarize the schedule, survey procedures, field data recording, and safety procedures. This operations and safety plan is a key element of quality assurance and control activities.
- Test all dive and photographic equipment onsite prior to the beginning of the surveys and conduct daily equipment checks.

In addition, the data analysis, described below, was accomplished in a fashion to provide verifiable photographic interpretations of the reef transect videos with QA procedures to estimate accuracy and error. Ten percent of all video transects were reanalyzed without coral identification to verify that transcription accuracy and error estimates are acceptable.

Section 3

DATA ANALYSIS AND PRESENTATION OF RESULTS

The field surveys of the fringing coral reef in Pago Pago Harbor were conducted March 21-29, 1995. The coral reef surveys will be used to evaluate the condition of, and changes to, the reef-face habitat in areas of the inner, middle, and outer Pago Pago harbor. These surveys are limited to providing semi-quantitative data on the type, percent cover of live reef corals and other benthic species. The intent of the surveys is to provide information necessary to generally characterize and document changes to the reef habitat. It is not intended that the data be used to quantitatively describe details of the reef habitat or communities. The surveys are targeted at examination of the benthic substrate and species. Reef fish identifications are not an objective of the study.

ANALYSIS OF VIDEO TAPES

The videotape transect records were analyzed and summarized by a qualified marine ecologist with tropical reef knowledge and several years of experience specifically in American Samoa. The videotape analysis involves repeated slow-frame viewing of the transect video to record estimates of live coral coverage and specific benthic genera. The percent of live coral was estimated at 5 meter intervals along the transect line, for 2.5 meter segments. Benthic genera identifications were made, as feasible, from the video record. Field survey data was then summarized from notes made during the video transect viewing.

Using mobile species like fish to assess ecological impacts or habitat quality on a relatively small scale is not feasible without conducting the survey over a long period of time. Many environmental and behavioral factors (season, lunar phase, time of day, tide, weather patterns, etc.) may influence the abundance of fish species in a given area at a given time. Using the sessile benthic community (primarily scleractinian corals) and habitat complexity and structure to assess the prevailing or average ecological condition introduces the least amount of bias due to immediate conditions and diver avoidance.

Data collection with video tapes of prescribed areas, or transects, reduces the limitation of SCUBA diver bottom time. However, some detail will be lost and some bias will be introduced by the camera and the camera operator. Use of video transects in this case reduced the ability to detect and distinguish between encrusting corals, coralline algae, sponges and other organisms. Camera operator bias can be introduced in several ways; traveling speed and distance from bottom, camera angle, straying from transect, recognition of organisms requiring closer focus to be identified by the video tape reviewer, and in some cases, not providing scale with the transect line as a reference.

Translation of the video tape records into semi-quantitative data required rough identifications, and rough estimations of sizes and percentage of areal coverage. Coral identification is only provided to the generic level. Levels of uncertainty vary and depend on colony size and shape

and the uniqueness of the colony form to certain genera (for example *Echinopora* and *Montipora* are easily confused by video inspection). Distance, angle and form of the colony can cause errors in estimating size and areal coverage. This is compounded by the inability to distinguish between encrusting organisms.

Although there are biases unavoidably introduced in a survey such as the one reported here, gross identification of the larger benthic organisms, including corals, and a general characterization of the habitat structure and complexity were achieved. Biological interpretations and projections of the results are difficult, and are especially vulnerable to an individual's predicated bias. However, for the purpose of detecting general habitat changes over long time periods the techniques used in this survey are acceptable and adequate to achieve the objectives of the NPDES permit condition.

REEF SURVEY RESULTS

The transect analyses notes are presented in Appendix A. Tables 3-1, 3-2a, 3-2b, and 3-3 summarize the semi-quantitative survey results. These summary tables provide the station characteristics, benthic or sessile organisms coverage, and hard coral coverage for each transect. Inner harbor transects S-1, S-2, S-3, IH-3, IH-4, and IH-5 are summarized in Table 3-1. Middle harbor transects MH-1, MH-2, MH-3, and MH-4 are summarized in Table 3-2a. Middle harbor transects MH-5, MH-6, MH-7, and MH-8 are summarized in Table 3-2b. Outer harbor transects OH-1, OH-2, OH-3, OH-4, and OH-5 are provided in Table 3-3. Copies of the video records were provided to ASEPA and USEPA as a separate attachment to this report.

Inner Harbor. The existing or remnant coral reef areas in the inner harbor are very limited as a result of shoreline filling, pier construction, and industrial and marine related activities. Three transect stations were established in the western end of the inner harbor (S-1, -2, and -3) at known remnant coral reefs or coral heads. These three transect locations consisted of soft substrates and silt-covered remnant coral heads and coral rubble. As in previous surveys, no live corals or other hard-substrate organisms were present.

Three additional stations were surveyed in the transition area from the inner to middle harbor (IH-3, -4, and -5). Sediments were observed to cover substantial areas of hard substrates at all depths. Station IH-3 had no observed live coral and IH-5 had 24 percent live coral cover at the 20-foot transect with 1 percent and zero cover at the 40 and 50 foot depths, respectively. These two stations are located along the reef face between Trading Point (immediately east of the cannery docks) and the rock jetty at Leloaloa (These stations both had less than 5-percent observed live coral cover at all depths during the 1993 survey). The reef front at these two stations consisted of steep, silt-covered, rubble slopes. Station IH-4, located 200 feet east of the fuel dock and on the north face of the basalt outcrop at Goat Island Point, had less than 7-percent live coral at all depths. Large areas of coralline algae were observed at IH-5.

Table 3-1.
Results of March 1995 Coral Reef Surveys:
Inner Harbor Transects

Station	S1	S2	S3	IH3			IH4			IH5		
Station Characteristics												
Depth (ft)	10-50	10-60	10-65	25	40	60	25	40	60	20	40	50
Percent Sand, Sediment & Rubble	100	100	95	96	78	100	87	88	90		25	99
Slope Description	G	FS	G/S	FS	S	G	W	W	S	FS	FS	G
Sessile Organisms (percent coverage)												
Algae							<1		<1			
Coralline algae				<1	4			1	1			
Sponges				<1	4	1	5	4	3	70	70	
Hydroids (+Ascidians)			2		14		1		3	3	4	1
Styllaster (hydrocorallina)												
Millepora (hydrocorallina)										4		
Zoanthids												
Soft Coral							<1					
Other Organisims			3	3								
Unidentified Biota												
Hard Coral (percent coverage)												
Pocillopora										<1		
Montipora												
Acropora												
Fungia								<1			1	
Herpolitha												
Porites												
Faviidae												
Diploastrea heliopora							3	6		3		
Echinopora												
Galaxea												
Lobophyllia												
Echinophyllia												
Styllophora												
Seriatopora												
Montastrea												
Hyrdophora												
Goniastrea												
Astreopora												
Unidentified Encrusting Forms									<1	20P	P	
Unidentified Digitate Coral												
Total Percent Live Hard Coral	0	0	0	0	0	0	3	7	1	24	1	0
Total Number of Hard Coral Genera	0	0	0	0	0	0	1	2	0	2	1	0
Total Hard Coral Genera per Station	0	0	0	0			2			3		

F* = Transect conducted on reef flat area
P = present (approximate coverage estimated)
<1 = 1% when calculating coverage
Unidentified not included in genera count
Coverage does not include Styllaster and Millepora
Slopes as below:
G = Gradual
FS = Fairly Steep
W = Vertical Reef Wall
S = Steep
F = Flat
T = Terraced

Table 3-2a.
Results of March 1995 Coral Reef Surveys:
Middle Harbor Transects

Station	MH1			MH2			MH3			MH4			
Station Characteristics													
Depth (ft)	25	40	60	25	40	60	2-5	25	40	2-5	25	40	60
Percent Sand, Sediment & Rubble			45	7	18	19	5	52	92		35	51	96
Slope Description	G	FS	FS	G	FS	FS	F*	G	G	F*	T/S	T/S	G
Sessile Organisms (percent coverage)													
Algae		1	1	64			38				2		
Coralline algae	64	75P	43		60	62	43	5		55	22	2	
Sponges	5	9	6	7	1	6	<1	6	2		5	3	2
Hydroids (+Ascidians)													
Styllaster (hydrocorallina)													
Millepora (hydrocorallina)	10			4							2		
Zoanthids					1			15	2		2	10	
Soft Coral								2			7	7	
Other Organisims												1	
Unidentified Biota													
Hard Coral (percent coverage)													
Pocillopora							10			3			
Montipora	5	10P	P	10	12	5		2		4	1		
Acropora				<1						6			
Fungia				<1	<1								<1
Herpolitha													
Porites	1	3P	P	1	2	1				30			
Faviidae					1	1							
Diploastrea heliopora	1			6				18	2		20	25	2
Echinopora		2P	P										
Galaxea													
Lobophyllia					2	2							
Echinophyllia			P										
Styllophora					2								
Seriatopora													
Montastrea													
Hyrdophora					1								
Goniastrea										<1P	4P		
Astreopora												1P	
Unidentified Encrusting Forms			5			5	5		2				
Unidentified Digitate Coral													
Total Percent Live Hard Coral	**7**	**15**	**5**	**19**	**21**	**14**	**15**	**20**	**4**	**44**	**25**	**26**	**3**
Total Number of Hard Coral Genera	**3**	**3**	**4**	**5**	**7**	**4**	**1**	**2**	**1**	**5**	**3**	**2**	**2**
Total Hard Coral Genera per Station	**5**			**9**			**3**			**8**			

F* = Transect conducted on reef flat area
P = present (approximate coverage estimated)
<1 = 1% when calculating coverage
Unidentified not included in genera count
Coverage does not include Styllaster and Millepora
Slopes as below:
G = Gradual
FS = Fairly Steep
W = Vertical Reef Wall
S = Steep
F = Flat
T = Terraced

Table 3-2b.
Results of March 1995 Coral Reef Surveys: Middle Harbor Transects

Station	MH5			MH6			MH7			MH8			
Station Characteristics													
Depth (ft)	25	40	60	25	40	55	25	40	60	2-5	25	40	60
Percent Sand, Sediment & Rubble	2	35	35	80	35	55	80	40	80	32	39	68	55
Slope Description	W	W	G	S	G	G	T/G	T/G	D	F*	S	S	G
Sessile Organisms (percent coverage)													
Algae				1	1	3				7			
Coralline algae	51P	P	15P	13	20P	20P	10	30	10	51	30	10	20P
Sponges	6	4P	17P	1	12	11P	3	2	1		10P	6	11P
Hydroids (+Ascidians)	3	P	15P										
Stylaster (hydrocorallina)													
Millepora (hydrocorallina)													
Zoanthids			15P	1	2	1							
Soft Coral			2P				3	8	1				
Other Organisims	<1	1							1				
Unidentified Biota		60							<1				
Hard Coral (percent coverage)													
Pocillopora										2			
Montipora	2P		<1	2	P	2		2	P		<1	3	P
Acropora	P				1								
Fungia				1							<1		<1
Herpolitha													
Porites	P			1	P			1		1		1	
Faviidae			<1		1			<1				1	
Diploastrea heliopora	20				4	8	3	10	4	3	5	8	2
Echinopora					4				P				P
Galaxea													
Lobophyllia													
Echinophyllia													
Styllophora													
Seriatopora													
Montastrea							1						
Hyrdophora													
Goniastrea								1					
Astreopora	P									<1P			
Unidentified Encrusting Forms	15				20			4	3	<1	2P	3	11P
Unidentified Digitate Coral											1		
Total Percent Live Hard Coral	37	0	2	4	30	10	4	19	7	8	10	16	14
Total Number of Hard Coral Genera	5	0	2	3	6	2	2	5	3	4	3	4	4
Total Hard Coral Genera per Station	6			7			7			8			

F* = Transect conducted on reef flat area
P = present (approximate coverage estimated)
<1 = 1% when calculating coverage
Unidentified not included in genera count
Coverage does not include Styllaster and Millepora
Slopes as below:
G = Gradual
FS = Fairly Steep
W = Vertical Reef Wall
S = Steep
F = Flat
T = Terraced

Table 3-3. Results of March 1995 Coral Reef Surveys: Outer Harbor Transects															
Station	**OH1**			**OH2**			**OH3**		**OH4**				**OH5**		
Station Characteristics															
Depth (ft)	**25**	**40**	**60**	**25**	**40**	**60**	**25**	**40**	**2-5**	**25**	**40**	**60**	**25**	**40**	**60**
Percent Sand, Sediment & Rubble	5	8	83	1	5	25	35	45	3		35	55		15	90
Slope Description	W	W	FS	T/FS	T/FS	T/FS	T/G	G/F	F*	T/W	S	G	W	FS	FS
Sessile Organisms (percent coverage)															
Algae			P		<1	1	2	<1	2			10			
Coralline algae	45	60	10	60	60	30	20	13	82	40	20	9	60	65	8P
Sponges	15	3	7P	1	6	12	<1			10	11		10	8	1
Hydroids (+Ascidians)			P											P	
Styllaster (hydrocorallina)	1	3								<1	<1				
Millepora (hydrocorallina)				4											
Zoanthids															
Soft Coral		1		5	15	1	2						1		
Other Organisims							8	10							
Unidentified Biota										7	30				
Hard Coral (percent coverage)															
Pocillopora				2			1		3				5		
Montipora	15	20P		20P		12	P			35	2P	3	12	1	
Acropora	10			<1		1	4	1	10			5	5		
Fungia															
Herpolitha															
Porites	5			5P	1		7	25				P	3	1	
Faviidae		1	1	3P	1	2				2		<1	1		
Diploastrea heliopora	2	<1				1									
Echinopora					P						1P	9			
Galaxea															
Lobophyllia															
Echinophyllia															
Styllophora															
Seriatopora													3		
Montastrea															
Hyrdophora					1										
Goniastrea															
Astreopora												1			
Unidentified Encrusting Forms		3			10	5				5		9		10	1
Unidentified Digitate Coral	2						20	3							
Total Percent Live Hard Coral	**34**	**25**	**0**	**31**	**13**	**21**	**32**	**29**	**13**	**43**	**3**	**28**	**29**	**12**	**1**
Total Number of Hard Coral Genera	**4**	**3**	**0**	**5**	**4**	**4**	**4**	**2**	**2**	**3**	**2**	**5**	**6**	**2**	**0**
Total Hard Coral Genera per Station	**5**			**8**			**4**		**6**				**6**		

F* = Transect conducted on reef flat area
P = present (approximate coverage estimated)
<1 = 1% when calculating coverage
Unidentified not included in genera count
Coverage does not include Styllaster and Millepora
Slopes as below:
G = Gradual
FS = Fairly Steep
W = Vertical Reef Wall
S = Steep
F = Flat
T = Terraced

Middle Harbor. The middle harbor region of Pago Pago Harbor extends approximately from Leloaloa to Aua Point on the northern and eastern shoreline, and from Goat Island Point to Tulutulu Point along the western shoreline. The middle harbor region includes areas of direct wave impacts along the northern shoreline, and two semi-enclosed embayments (off the villages of Utulei and Aua). Eight stations were located to represent the range of reef exposures around the middle harbor.

Stations MH-1 and MH-2, were located along the northern shore that receives direct wave impacts from the south. The transects conducted at these two stations had 5- to 21-percent live coral at the 25-foot transect depth. The highest values observed were at the 40-foot depth with coverages of hard coral of 15- and 21-percent, respectively. The highest coverages at these stations were 15- and 19-percent, respectively, at 40-foot depths. The 25- and 40-foot transects at these two stations showed 10 to 35 percent sand/silts and rubble coverage in 1993, which represented a substantial increase over the 1991 values (<1-percent). This increase in sands/silts and rubble coverage is believed to be due to the severe impacts of Tropical Cyclone Val in December 1991 (Tropical Cyclones Ofa, in February of 1990, and Lin in February of 1993 are other recent major storms affecting American Samoa). Evidence of the hurricane wave forces is exhibited by the six longline vessels that are grounded on the reef flats between Leloaloa (site of IH-5) and the harbor navigation range marker (site of MH-1). The amount of sand and rubble was less for the 1995 survey, which may indicate potential removal or downslope migration f this material.

The results of the reef surveys at MH-3 and MH-4, located inside the semi-enclosed embayment between Leasi Point and Aua Point, show moderately diverse coral representation and zoanthid colonies were the dominant benthic organism. The 25- and 35-/40-foot transects at these stations had 20- to 51-percent live coral, similar to the observations from the 1993 survey. Both stations MH-3 and MH-4 showed some siltation of flat surfaces, probably due to sediments released from the stream at Aua and from resuspended bottom sediments in the embayment. Some indication of wave impact damage had previously been observed in the shallow (<20 feet) depths near the fringing reef at MH-3 during the 1993 survey.

Four stations (MH-5, -6, -7, and -8) were located along the western shoreline of the middle harbor, and these reef areas have established hard and soft corals communities. The 25- and 40-foot transects at MH-5 and -6, located at more wave-exposed sites, had 10- to 60-percent live coral and 5- to 50-percent sand/silt or rubble coverage, similar to the 1993 survey observations. In comparison, the 25- and 40-foot transects at MH-7 and -8 showed 3- to 18-percent live coral coverage and 20- to 90-percent sand/silts and rubble coverage, which was less coral coverage and somewhat higher sand a rubble coverage than previously observed. MH-7 and MH-8 are located in a semi-enclosed embayment and clearly show siltation resulting from Vailoa stream discharges and sediments resuspended in the excavated reef flat between the Pago Pago Yacht Club and the park. The number of coral genera observed in this 1995 survey was higher than the 1991 and 1993 survey observations at these middle harbor stations.

Outer Harbor. The outer harbor region extends from Tulutulu Point to Niuloa Point on the western shoreline, and from Anasosopo Point to Breakers Point on the eastern shoreline. Five

stations were located in the outer harbor, two along the eastern shoreline (OH-1 and OH-5), and three on the western shoreline. The two east shoreline stations and OH-2 on the south face of Tulutulu Point are all directly wave-exposed sites. The steep reef face structure, percentages of live corals, silt coverage, and benthic diversity observed at stations OH-1 was similar to the reef face conditions at MH-5, located on the south face of Goat Island Point, in 1993, and the 1995 survey showed some increases in hard coral coverages.

Transect conducted at 25- and 40-feet at Station OH-5 consists primarily of a steep slope of staghorn coral (*Acropora)* rubble with coralline algae and sponges on the rubble. This reef face shows indications of typical wave damage down to 50 feet depth, and the sand/silt coverage at these two transect depths was less than 5-percent. At the 60-foot depth transect the reef face changes to mostly sand and silt with few coral outcroppings. Station OH-5 is also located approximately 600 feet from the new joint cannery outfall diffuser. No evidence of the wastewater impacts or settleable solids was observed at this station.

Stations OH-3 and OH-4, located on a north-face in the semi-enclosed embayment off Fagaalu, had live coral coverages of 32- to 43-percent at 25 feet and only 3- to 29-percent at 40 feet depth. The observed live coral and sessile organism diversity at stations OH-3 and OH-4 were comparable to the middle harbor stations, and may be influenced by the siltation from Fagaalu Stream, although hard coral coverage was higher than in the middle harbor. Station OH-2, located in a wave-exposed area yielded the highest diversity and coverage of hard corals in 1993 but lower values were observed in the 1995 survey.

DISCUSSION OF RESULTS

This report presents the results of the baseline coral reef survey conducted to monitor possible changes in reef conditions following relocation of the canneries discharge points and the implementation of high strength waste segregation. These coral reef field surveys were also designed and conducted to allow comparisons of the reef conditions between areas of the inner, middle, and outer Pago Pago harbor. Comparisons between regions in the harbor and between the biannual surveys are be made to characterize and document any changes.

A general qualitative comparison can be made between this survey and the previous surveys done by CH2M HILL in 1991 and 1993. The results of this comparison include the following:

- The inner harbor seabed consists of silty muds and areas of silt covered remnant coral structures. The remnant reef fronts surveyed in the western half of the inner harbor do not appear to sustain live hard or soft corals. Hard coral coverage at IH-5 (average for all depths), in the transition area between the inner an middle harbor, appears to be higher in 1995 than for the previous surveys. There are no other apparent changes to the seabed conditions in the inner harbor between the 1991, 1993 and 1995 surveys.

- The middle harbor region includes a wide range of exposed and protected reef areas. The 1991 and 1993 surveys both show live coral with an average of 18- and 20-

percent, respectively, for all transect depths. The 1995 survey indicates an average coverage of 16-percent. Stations MH-4 and MH-8 appear to show distinct increases of coverage for 1995. MH-2 and MH-6 appear to show decreases in coverage but similar diversity for 1995 compared to the previous surveys. MH-1 and MH-7 show little variation among the three surveys (although MH-7 indicates possible increases in diversity. MH-3 exhibits a decrease over 1993 results but is similar to the 1991 results. Observations at MH-5 for 1995 and 1993 are similar and lower than the coverages observed during 1991. No clear trends are seen over the entire suite of middle harbor stations.

- The hard coral coverage at OH-2 was lower for the 1995 survey than for the 1993 survey (which was very high at 62 percent), but similar to the 1991 survey. Station OH-1 results indicate a possible trend of increasing coral coverage. Stations OH-3 and OH-4 show no distinct trends. Station OH-5 is the closest station to the discharge and the observations indicate that hard coral coverage has increased at this station.

- There is no clear overall trend in coverage or diversity throughout the harbor. Excluding stations S-1, S-2, and S-3, the average coverage for all stations was 17.2-percent in 1995, 19.5-percent in 1993, and 16.5-percent in 1991. (Excluding the high value of 62-percent at OH-2 in 1993, the 1993 value would be 16.5-percent.)

Tables 3-4, 3-5, and 3-6 summarize the results of the two studies in terms of number of hard coral genera identified at each station and the depth averaged percent coverage of hard corals. Differences in details such as variability with depth, actual numbers and extent of various genera, and other station characteristics can be found by comparing Tables 3-1,3-2a and b, and 3-3 with previous results provided in the report for the 1993 survey.

Table 3-4
Summary Results of the 1995, 1993 and 1991 Coral Reef Surveys
for Inner Harbor Stations

STATION	S1	S2	S3	IH3 (1)	IH4	IH5 (2)
March 1995 Survey						
Total Percent Live Hard Coral Coverage (depth average)	0	0	0	0	4	8
Total Number of Live Hard Coral Genera Identified per Station (all depths)	0	0	0	0	2	3
February 1993 Survey						
Total Percent Live Hard Coral Coverage (depth average)	0	0	0	0	4	3
Total Number of Live Hard Coral Genera Identified per Station (all depths)	0	0	0	0	2	4
January 1991 Survey						
Total Percent Live Hard Coral Coverage (depth average)	0	0	0	0	3	2
Total Number of Live Hard Coral Genera Identified per Station (all depths)	0	0	0	0	2	3

(1) Reef flat data excluded from 1993 and 1995 data to make data bases comparable.
(2) 50-foot data excluded from 1993 and 1995 data to make data bases comparable.

Table 3-5
Summary Results of the 1995, 1993 and 1991 Coral Reef Surveys
for Middle Harbor Stations

STATION	MH1	MH2	MH3	MH4	MH5 (1)	MH6	MH7 (1)	MH8
March 1995 Survey								
Total Percent Live Hard Coral Coverage (depth average)	9	18	13	33	13	15	10	16
Total Number of Live Hard Coral Genera Identified per Station (all depths)	5	9	3	8	6	7	7	6
February 1993 Survey								
Total Percent Live Hard Coral Coverage (depth average)	11	34	30	15	13	30	9	7
Total Number of Live Hard Coral Genera Identified per Station (all depths)	5	7	6	4	3	7	4	6
January 1991 Survey								
Total Percent Live Hard Coral Coverage (depth average)	13	22	10	20	27	27	12	9
Total Number of Live Hard Coral Genera Identified per Station (all depths)	4	8	9	7	3	7	3	5

(1) Reef flat data excluded from 1991 data to make data bases comparable.

Table 3-6
Summary Results of the 1995, 1993 and 1991 Coral Reef Surveys for Outer Harbor Stations

STATION	OH1	OH2 (1)	OH3 (2)	OH4 (3)	OH5 (4)
March 1995 Survey					
Total Percent Live Hard Coral Coverage (depth average)	20	22	31	25	21
Total Number of Live Hard Coral Genera Identified per Station (all depths)	5	8	4	6	6
February 1993 Survey					
Total Percent Live Hard Coral Coverage (depth average)	13	62	37	18	6
Total Number of Live Hard Coral Genera Identified per Station (all depths)	6	9	5	7	4
January 1991 Survey					
Total Percent Live Hard Coral Coverage (depth average)	8	23	38	25	8
Total Number of Live Hard Coral Genera Identified per Station (all depths)	4	10	3	14	7

(1) 60-foot data excluded from 1993 and 1995 data to make data bases comparable.
(2) Reef flat data excluded from 1991 data to make data bases comparable.
(3) Reef flat data excluded from 1993 and 1995 data to make data bases comparable.
(4) 60-foot data excluded from 1993 and 1995 data to make data bases comparable.

Appendix A

March 1995 CORAL REEF FIELD SURVEYS

Appendix A

March 1995 CORAL REEF FIELD SURVEYS

CORAL REEF TRANSECT ANALYSES
FIELD SURVEYS CONDUCTED MARCH 21 -29, 1995
BY CH2M HILL
[VIDEO INTERPRETATIONS BY TROY BUCKLEY]

The following descriptions of each transect indicate the estimated percent areal coverage (usually in parentheses) summarized over the entire transect for substrate type and distinguishable types of biota. The locations of the reef transects in Pago Pago Harbor are shown in Figures 1 and 2 in this report.

INNER HARBOR, STATION S-1

Visibility was very poor during this single continuous video transect that proceeded from near shore (about 10-foot depth) downward into the harbor basin (to about 50-foot depth). The bottom started out as mostly silt, sand and rubble with a few larger rocks that appear to be covered with silt and some algae. Further along, the substrate was primarily silt (85%) with some sand visible at the numerous burrow openings and a few rocks (10%) (about 50 cm diameter) were sometimes encountered. Refuse (5%) was common on the bottom in this area, including beverage cans, two plastic bags and some metal refuse. Although the poor visibility precluded direct viewing of fishes for the most part, the presence of fishes in this area could be inferred from the small plumes of silt stirred up directly in front of the camera. Visibility improved a little with depth and at a silt and algae covered pile (low but about 2 meters wide) of coral rubble, machinery and a cable spool a pair of vagabond butterflyfish (*Chaetodon vagabundus* - chaetodontidae) and a sapphire damsel (*Pomacentrus pavo* - pomacentridae) were seen. The transition from a primarily silt and sand bottom to a primarily silted dead coral bottom (70%) with patches of silt and sand (28%) was fairly abrupt. Old and new beverage cans (2%) were also commonly seen in this area. The dead coral bottom was composed of mostly of semi-foliaceous plates, and at toward the end of the transect, these plates and some rubble were almost 100% of the bottom cover. A layer of fine silt covered the majority of the hard structures, but a sponge was seen. Surgeonfishes (Acanthuridae) including the brown tang (*Zebrasoma scopas*), several sapphire damsels and probably goatfishes (mullidae) were observed in this area.

INNER HARBOR, STATION S-2

This single continuous dive video transect from 10- to 60-foot depths covered a primarily silt and sand bottom (90%) that is littered with several small piles of silt covered refuse and debris (10%). The bottom appears to have a diatom film on the sediment where it is not disturbed by the numerous burrows that perforate the top silty layers. The refuse consists of rope, cable, metal and many beverage cans. A flametail snapper (*Lutjanus fulvus* - lutjanidae) was seen on this transect.

INNER HARBOR, STATION S-3

Depths of 10 to 65 feet were covered by this single continuous video transect that encountered several different types of substrate and habitat. Initially, the bottom consisted of silt and rubble (90%) that was littered with debris (10%) including a culvert (about 2 meters long by 40 cm in diameter), cables, bottles and cans. Snappers (lutjanidae), goatfishes (mullidae), damselfishes (pomacentridae) including sergeant damselfish (*Abudefduf* sp.), surgeonfishes (acanthuridae), and a moorish idol (*Zanclus cornutus* - zanclidae) were seen in this area. Several sponges, a pair of bicolor angelfish (*Centropyge bicolor* - pomacanthidae) and the brown tang (*Zebrasoma scopas* - acanthuridae) were seen in an area of silt-covered coral rubble and remnant semi-foliaceous plates (perhaps *Montipora, Echinopora* or *Turbinaria*). Further along the transect a wall of a large remnant coral formation was encountered that was covered by silt (5%) sponges (5%) and encrusting organisms (90%) (probably coralline algae, sponges, hydroids and ascidians). A large bivalve was attached to the substrate of this fairly comlex habitat and a grouper (serranidae), Pacific double-saddle butterflyfish (*Chaetodon ulietensis* - chaetodontidae) and soldierfish (*Myrpristis* sp. - holocentridae) were swimming nearby. A series of large shields of dead coral (probably *Diploastrea heliopora*) provide little complexity and give way to a silt and rubble bottom where a few tufts of filamentous algae find purchase.

INNER HARBOR, STATION IH-3, 25-FOOT TRANSECT

At a depth of 25 feet, large coral blocks and consolidated coral structures were dispersed over a mostly silt, sand and coral rubble bottom (80%). Most solid surfaces were covered with loose silt (16%), but sponges were present (<1%), coralline algae appeared to encrust some surfaces (<1%), and some of the silt appeared to be consolidated by epiphytes (3%) (perhaps algae, hydroids and ascidians). A spiny sea urchin (*Diadema* sp.) and 2 unidentified cowries (cypraeidae) were seen on the transect.

INNER HARBOR, STATION IH-3, 40-FOOT TRANSECT

At a depth of 40 feet the underlying substrate was primarily loosely consolidated plate-like structures and rubble, although a considerable amount of refuse and debris was also present (10%). Loose silt (68%) covered most surfaces, but it appeared that some of the silt was consolidated by epiphytes (14%) (perhaps hydroids and ascidians). Some surfaces protected from silt supported sponges (<1%) or were encrusted by coralline algae (4%) and sponges (3%). Refuse included a bottle, many beverage cans, rope and a plastic bag, and a palm trunk and fronds occurred on the transect. A few damselfishes (pomacentridae), cardinalfishes (apogonidae), and a juvenile bird wrasse (*Gomphosus varius* - labridae) were seen on the transect.

INNER HARBOR, STATION IH-3, 60-FOOT TRANSECT

At a depth of 60 feet the substrate alternates between areas of dead semi-foliaceous coral plates (probably *Echinopora*) and an almost entirely silt bottom (60%). Burrowing organisms have colonized the heavily silted areas, and two beverage cans and two bottles (<1%) were seen. The silt (39%) was fairly dark (probably terrigenous or nutrient laden) and covered most of the substrate. Sponges (1%) only occurred on coral structures that rose above the silt bottom. An algal film appeared to be growing on the surface of the silt in one small area.

INNER HARBOR, STATION IH-4, 25-FOOT TRANSECT

At a depth of 25 feet, a silt and rubble bottom (49%) alternated with low coral structures of limited complexity. Loose silt (37%) covered most surfaces of the coral structures (mostly dead *Diploastrea heliopora*), and silt appeared to be consolidated in a few areas by ascidians (<1%) and hydroids (<1%). Living biota occurred almost exclusively on the coral structures, and was dominated by partial colonies of *D. heliopora* (3%) that had not become smothered by the silt. Coralline algae (5%), encrusting sponges (3%), sponges (2%), soft coral (alcyonacea) (<1%), and unidentified algae (<1%) covered the remainder of the hard substrate. A few beverage cans and a bottle were covered with silt (<1%), and several damselfish (pomacentridae) were seen on the transect.

INNER HARBOR, STATION IH-4, 40-FOOT TRANSECT

At a depth of 40 feet, there was very little habitat complexity, and silt covered most of the bottom. Silt and sand (45%), silt and rubble (30%), and low coral formations covered with silt (10%) dominated the substrate. A mass of intertwined tree branches (2%) and two silt covered bottles (1%) were noted. Living benthic cover included *Diploastrea heliopora* (6%), a small *Fungia* (<1%) and sponges (4%) and probably coralline algae (1%). The small (50 to 100 cm) surviving patches of *D. heliopora* on larger shields are probably the result of heavy siltation that has killed most of the original colony. Fishes seen on the transect were damselfish (pomacentridae), bannerfish (*Heniochus* sp. - chaetodontidae) and sabretooth blenny (blenniidae).

INNER HARBOR, STATION IH-4, 60-FOOT TRANSECT

At a depth of 60 feet, the slope was dominated by a silt and sand bottom (45%) with scattered low coral formations. This bottom type was interrupted occasionally by dead *Diploastrea heliopora* shields and terracing plates. The hard substrate was covered with loose silt and sand (45%), sponges (2%), ascidians (2%), zoanthids (1%), encrusting coral (<1%), reddish looking algae (<1%), and probably hydroids (1%), encrusting sponges (1%) and coralline algae (1%). A cardinalfish (apogonidae) was seen.

INNER HARBOR, STATION IH-5, 20-FOOT TRANSECT

At a depth of 20 feet, dead coral formations and some coral rubble dominate the substrate, but the complexity of the habitat is fairly low. Coralline algae encrusts most surfaces (70%) but has not consolidated the rubble. Sponges (3%) are conspicuous throughout the transect, and encrusting sponges may also be common. Live coral cover is high relative to past transects, and is probably the result of a slightly different location of this station. Encrusting colonies (of *Montipora* and possibly some *Porites*) were difficult to distinguish but they appeared to be prevalent (20%). Other corals included *Diploastrea heliopora* (3%), *Pocillipora* (<1%), and encrusting colonies of *Millepora* (4%) (hydrocorallina, a non-scleractinian coral). Many fishes were seen including damselfishes (pomacentridae) of the genera *Chromis, Chrysiptera* and perhaps *Stegastes*; surgeonfishes (acanthuridae) of the genera *Acanthurus, Ctenochaetus* and *Zebrasoma*; sabretooth blenny (blenniidae); wrasse (labridae); snapper (lutjanidae); and rabbitfish (siganidae).

INNER HARBOR, STATION IH-5, 40-FOOT TRANSECT

At a depth of 40 feet, the habitat was about half terracing plates of dead coral colonies and half unconsolidated coral rubble providing fair complexity with a variety of interstices. Silt covering rubble (15%) and silt covering coral formation (10%) was present. Sponges (2%), encrusting coralline algae (70%) and perhaps encrusting sponges (2%) covered most of the silt-free substrate. Live coral was limited to one *Fungia* (1%), but some encrusting coral colonies may also have been present. Surgeonfish (acanthuridae), soldierfish (*Myrpristis* - holocentridae), damselfish (pomacentridae) and a bicolor angelfish (*Centropyge bicolor* - pomacanthidae) were seen on the transect.

INNER HARBOR, STATION IH-5, 50-FOOT TRANSECT

At a depth of 50 feet, the bottom is mostly sand and silt (79%) with some silt covered coral rubble (20%) scattered in places. Several large burrows were seen especially in the first 15 meters of the transect where there is less coral rubble. Two sponges (1%) were the only living benthic cover identified. Goatfish (mullidae) and two flametail snappers (*Lutjanus fulvus* - lutjanidae) were seen.

MIDDLE HARBOR, STATION MH-1, 25-FOOT TRANSECT

At a depth of 25 feet, the habitat was composed of a variety of coral formations that provided a wide size-range of crevices and holes. The hard substrate was encrusted with coralline algae (64%) and many small and encrusting sponges (5%). Living corals were represented by encrusting colonies of *Montipora* (5%), *Porites* (1%), *Millepora* (10%) (hydrocorallina, a non-scleractinian coral), and a young (40 by 50 cm) colony of *Diploastrea heliopora* (1%). Several damselfish (pomacentridae), surgeonfish (acanthuridae), a moorish

idol (*Zanclus cornutus* - zanclidae), bannerfish (*Heniochus* sp. - chaetodontidae) and butterflyfish (*Chaetodon* sp. - chaetodontidae) were present.

MIDDLE HARBOR, STATION MH-1, 40-FOOT TRANSECT

At a depth of 40 feet, the habitat complexity decreased and was dominated by loose and partially consolidated coral rubble and plates of various sizes. Although the encrusting organisms were not really distinguishable, it appeared that coralline algae (75%) was dominant, followed by encrusting and plate-like corals - *Montipora* (10%), *Echinopora* (2%), and *Porites* (3%), and encrusting sponges (7%). Several small sponges (2%) and a patch of fleshy algae (probably *Turbinaria ornata*) (1%) also occurred. Fishes observed on the transect include many surgeonfishes (acanthuridae) and damselfishes (pomacentridae), a few wrasses (labridae), and a butterflyfish (*Chaetodon* sp. - chaetodontidae).

MIDDLE HARBOR, STATION MH-1, 60-FOOT TRANSECT

At a depth of 60 feet, the habitat alternated between dead coral plates that formed a fairly complex terraced slope, semi-consolidated coral rubble (40 to 60 cm plates and massive forms) and gentler sloping areas with smaller coral rubble. The silt cover (45%) was highest at the beginning of the transect. Coralline algae (43%) appeared to be consolidating the coral rubble and increased along the transect. Sponges (1%) were small and frequently attached to the underside of the substrate, and encrusting sponges (5%) were probably also present. Small (5 to 30 cm) encrusting coral colonies (5%) and one digitate coral colony (<1%) were probably *Montipora, Echinopora, Porites,* or *Echinophyllia.* A fleshy algae (probably *Turbinaria ornata*) (1%) occurred in two small patches. A lemonpeel angelfish (*Centropyge flavissimus* - pomacanthidae), a butterflyfish (*Chaetodon* sp. - chaetodontidae), a large remora (echeneididae), and several surgeonfishes (acanthuridae) were observed on this transect.

MIDDLE HARBOR, STATION MH-2, 25-FOOT TRANSECT

At a depth of 25 feet, the silt-free habitat of complex coral formations was interrupted by 2 narrow channels of sand and rubble (7%). Coralline algae (64%) encrusted most of the dead coral formations, sponges were common (2%), and encrusting sponges (5%) probably also occurred. The live coral cover was dominated by encrusting colonies of *Montipora* (10%), *Porites* (1%), and the non-scleractinian coral, *Millepora* (hydrocorallina) (4%). Some *Diploastrea heliopora* (6%) colonies appeared to be recovering from past silt damage, and *Acropora* (<1%) and *Fungia* (<1%) were also identified. Fishes identified at this transect were surgeonfishes (*Acanthurus* sp. - acanthuridae), striped bristletooth (*Ctenochaetus striatus* - acanthuridae), brown tang (*Zebrasoma scopas* - acanthuridae), wrasses (labridae),

flametail snapper (*Lutjanus fulvus* - lutjanidae), juvenile black snapper (*Macolor niger* - lutjanidae), and many damselfish (pomacentridae).

MIDDLE HARBOR, STATION MH-2, 40-FOOT TRANSECT

At a depth of 40 feet, the consolidated rubble and coral formations were free of silt except where interrupted by 2 channels of silt, sand and small rubble (18%). Coralline algae (60%) appeared to encrust most hard surfaces, but encrusting sponges and corals may not have been detected. The few sponges (1%) on the transect were small, and a small patch of zoanthids (1%) was seen. Some encrusting coral colonies were distinguishable, especially in the last 10 meters of the transect, and included *Montipora* (12%), *Porites* (2%), and faviidae (1%). Large (>1 meter) colonies of *Lobophyllia* (2%) were broken apart with only about 20 corallites remaining alive. Other corals encountered were *Fungia* (<1%), small branching colonies of *Styllophora* (2%) (or perhaps *Pocillopora*), and an unidentified colony of perhaps *Hydnophora* (1%). Two spiny sea urchins, *Diadema* sp., were visible in small caves, and fishes seen included a pair of butterflyfish (*Chaetodon* sp. - chaetodontidae), wrasse (labridae), goatfish (mullidae), and surgeonfishes (acanthuridae).

MIDDLE HARBOR, STATION MH-2, 60-FOOT TRANSECT

At a depth of 60 feet, the low habitat was almost entirely coral rubble with a few remnant coral structures. The transect crossed a patch of sand and silt bottom (3%), and a layer of silt (15%) covered rubble and coral structures adjacent to it. Two ropes crossed near the end of the transect. The few sponges (1%) on the transect were small, but encrusting sponges (5%) may also have been present. Most solid surfaces appeared to be encrusted by coralline algae (62%). Encrusting *Montipora* (5%), massive *Porites* (1%), massive faviidae (1%), about 25 remnant corallites of *Lobophyllia* (2%), and many small (<10 cm) delicate plates (5%) (that are probably *Porites* or *Montipora*) comprised the living coral cover. Fishes seen on or near the transect were the moorish idol (*Zanclus cornutus* - zanclidae), juvenile black snapper (*Macolor niger* - lutjanidae), juvenile surgeonfishes (acanthuridae), and a school of large unicornfish (probably *Naso hexacanthus* - acanthuridae).

MIDDLE HARBOR, STATION MH-3, REEF TOP TRANSECT

The habitat at the reef margin was fairly complex with several caves, valleys and crevices. Most surfaces appeared to be covered by an algal film (65%) (perhaps diatoms), but coralline algae (20%) was also common. A fleshy algae (perhaps *Halimeda* sp.) (5%), sponges (<1%), and several *Pocillopora* coral colonies (10%) were also noted. Sergeant damselfish (*Abudefduf* sp. - pomacentridae), surgeonfishes (*Acanthurus* sp. and *Ctenochaetus* sp. - acanthuridae), wrasses (labridae), and parrotfish (scaridae) were seen swimming off the reef as the diver approached.

On the reef flat, the habitat complexity decreased with distance from the reef margin with coral rubble (8%) and some sand (2%) had accumulated in low areas. Coralline algae encrusted most surfaces of the substrate (65%), but a green algae (5%) was also present in places. Live coral cover was mostly encrusting corals (10%) with some dense patches of *Pocillopora* (10%). Many fish were seen on this transect including wrasses (labridae), reticulated butterflyfish (*Chaetodon reticulatus* - chaetodontidae) and other butterfly fish.

MIDDLE HARBOR, STATION MH-3, 25-FOOT TRANSECT

At a depth of 25 feet, the habitat was dominated by large (1 to 7 m) shields of *Diploastrea heliopora* and complex dead coral formations that provided hard substrate above a few low areas of silt and sand (25%). A few burrow openings occurred in the silt and sand pockets. The silt layer covering coral rubble (15%) and silt on the coral formations (12%) was thin. Zoanthids (15%), soft corals (alcyonacea) (2%), sponges (<1%), encrusting sponges (5%) and coralline algae (5%) occupied most of the dead coral formations. Live coral cover was composed of *D. heliopora* (18%) and encrusting *Montipora* (2%). Fish observed on the transect include surgeonfish (acanthuridae), damselfish (pomacentridae) and bannerfish (*Heniochus* sp. - chaetodontidae).

MIDDLE HARBOR, STATION MH-3, 40-FOOT TRANSECT

At a depth of 40 feet, terrigenous silt (60%) that was easily resuspended covered the bottom, but some silt covered coral structures and plate rubble (32%) add some relief. The small portions of the coral structures that are not blanketed by silt, supported sponges (2%), and zoanthids (2%) were seen in the silt and rubble. A large *Diploastrea heliopora* (2%) remnant with only patches of living corallites and an unidentified encrusting coral colony (2%) were the only living corals observed. The soft silt and sand bottom is perforated with (probably stomatopod shrimp or marine worm) burrows.

MIDDLE HARBOR, STATION MH-4, REEF TOP TRANSECT

On the reef margin, structural complexity was high. Coralline algae (50%) dominated the benthic cover, but live coral cover was represented by massive (1 meter) colonies of *Porites* (35%), encrusting *Montipora* (5%), and *Pocillopora* (5%). A large school of silvery baitfish was milling about, and parrotfish (scaridae), surgeonfish (acanthuridae), a lemonpeel angelfish (*Centropyge flavissimus* - pomacanthidae), and damselfishes (pomacentridae) including blue devils (*Chrysiptera cyanea*) were observed.

The habitat on the reef top was fairly complex with many crevices, holes and structural depressions. Coralline algae (60%) remained the dominant benthic cover on the reef flat. Massive *Porites (lobata?)* (15%) formed 'micro-atolls' and colonies of *Porites (rus?)* (10%) occurred in lower areas. Other corals that were observed include *Pocillopora* (1%),

Goniastrea(?) (1%), encrusting *Montipora* (2%), and small (15 cm) colonies of delicately branching *Acropora* (11%). A grouper (serranidae) was seen on the reef flat.

MIDDLE HARBOR, STATION MH-4, 25-FOOT TRANSECT

At a depth of 25 feet the habitat alternated between coral formations and chutes of silt, sand and small rubble (20%). Silt (10%) covered some of the consolidated coral formations, and silt-free rubble (5%) also occurred. Sponges (5%) and soft corals (alcyonacea) (7%) were common on hard substrates, and zoanthids (2%), coralline algae (22%), and patches of filamentous algae (2%) also occurred. Damaged *Diploastrea heliopora* (20%) dominate the live coral cover, but encrusting forms of *Montipora* (1%), *Goniastrea(?)* (4%) and the non-scleractinian *Millepora* (hydrocorallina) (2%) also occurred. Surgeonfishes (acanthuridae), lemonpeel angelfish (*Centropyge flavissimus* - pomacanthidae), and damselfishes (pomacentridae) including several blue devils (*Chrysiptera cyanea*) were observed.

MIDDLE HARBOR, STATION MH-4, 40-FOOT TRANSECT

At a depth of 40 feet the habitat had little complexity and was dominated by silt on low coral formations, sand and rubble. Overall, silt, sand and rubble (45%) dominated the substrate, but silt on solid structures (5%) also occurred. Four beverage cans and bottles (1%) covered in silt occurred on the transect. Sponges (3%), soft corals (alcyonacea) (7%) and zoanthids (10%) were common, but coralline algae (2%) and an anemone (1%) were rare. Live corals were dominated by remnants of large *Diploastrea heliopora* (25%) shields, but an unidentified encrusting corals, perhaps *Astreopora* (1%) also occurred. Soft corals (alcyonacea) and large shields of *D. heliopora* occurred near the marker stake but not on the transect. Fishes on the transect were several types of damselfish (pomacentridae) including blue devils (*Chrysiptera cyanea*), a bannerfish (*Heniochus* sp. - chaetodontidae), and goatfish (mullidae).

MIDDLE HARBOR, STATION MH-4, 60-FOOT TRANSECT

At a depth of 60 feet, the transect was at the base of the coral slope, and was mostly silt and sand (70%) and silt on rubble (15%). Two silt covered cans were noted. The silt on the low, semi-foliaceous plates and remnant massive structures (10%) appeared to be somewhat consolidated by various epiphytes. Sponges (2%), small remnants of *Diploastrea heliopora* (2%) colonies, and a nearly silt-smothered *Fungia* (<1%). Much larger colonies of *D. heliopora* occurred adjacent to the transect. Fishes seen on the transect were surge demoiselle (*Chrysiptera leucopoma* - pomacentridae), long-nosed butterflyfish (*Forcipiger* sp. - chaetodontidae), regal angelfish (*Pygoplites diacanthus* - pomacanthidae), a pair of moorish idols (*Zanclus cornutus* - zanclidae), and a large snapper or grouper (lutjanidae or serranidae). A (tiger?) cowrie (cypraeidae - gastropod mollusc) was also seen.

MIDDLE HARBOR, STATION MH-5, 25-FOOT TRANSECT

At a depth of 25 feet the habitat was comprised of a variety of fairly complex living and dead coral formations, coral rubble, and small amounts of sand (2%) accumulated only on a few horizontal surfaces. Encrusting coralline algae (maybe 49%), sponges (3%), and ascidians (3%) were difficult to distinguish. Sponges (3%) were common, and a jagged-lipped oyster (bivalve mollusc) (<1%) and calcareous algae (2%) were found. Live coral was dominated by recovering shields of *Diploastrea heliopora* (20%), but encrusting corals (15%), including *Montipora, Porites* and perhaps some *Acropora* and *Astreopora*, and a digitate colony of *Montipora(?)* (2%) also occurred. A variety of fish occur on the transect including damselfishes (*Abudefduf* sp., *Chrysiptera leucopoma, Chrysiptera cyanea, Chromis iomelas* - pomacentridae), butterflyfish and bannerfish (*Chaetodon* sp., *Forcipiger* sp., *Heniochus varius - chaetodontidae)*, soldierfish and squirrelfish (holocentridae), and cardinalfish (apogonidae).

MIDDLE HARBOR, STATION MH-5, 40-FOOT TRANSECT

At a depth of 40 feet, the near vertical wall was terraced with a series of ledges and larger overhangs. Silt and sand (35%) covered most horizontal surface and appeared to be mostly consolidated by coralline algae and hydroids. Vertical and downward facing surfaces were encrusted with unidentified biota (60%) - probably sponges, coralline algae, and ascidians. Large sponges (4%) and a gorgonian(?) (1%) were also attached to silt-free surfaces. A bannerfish (*Heniochus* sp. - chaetodontidae) was noted on the transect.

MIDDLE HARBOR, STATION MH-5, 60-FOOT TRANSECT

At a depth of 60 feet, the habitat was fairly complex on a nearly vertical wall. Ledges and most horizontal surfaces on the first half of the transect were predominantly covered by silt and sand (35%) that appeared to be partially consolidated by coralline algae and other epiphytes. Less silt was present on the second half of the transect. Sponges (2%) occurred mostly in the first half of the transect. Hard substrate was probably encrusted by coralline algae (maybe 15%), sponges (maybe 15%), ascidians (maybe 15%), zoanthids (maybe 15%), and maybe some soft coral (alcyonacea) (2%). Live coral cover is limited to encrusting *Montipora* (<1%) and faviidae (<1%). The angelfishes (pomacanthidae) - regal angelfish (*Pygoplites diacanthus*), bicolor angelfish (*Centropyge bicolor*) and lemonpeel angelfish (*Centropyge flavissimus*) - and damselfish (pomacentridae) were identified.

MIDDLE HARBOR, STATION MH-6, 25-FOOT TRANSECT

At a depth of 25 feet, the transect followed a transition from an entirely silt substrate to consolidated coral formations and rubble with little silt. A rope crossed the transect about five meters from the marker stake. Silt (45%), silt-covered rubble (15%) and silt-free rubble (15%) provided little habitat complexity. The solid substrate was partially covered by silt (5%), encrusted by coralline algae (13%), and supported sponges (1%), zoanthids (1%), and a fleshy calcareous algae (1%). Live coral was limited to encrusting *Porites* (1%), some encrusting and plate-like *Montipora* (2%), and two solitary *Fungia* (1%). A few damselfishes were seen.

MIDDLE HARBOR, STATION MH-6, 40-FOOT TRANSECT

At a depth of 40 feet, the amount of silt decreased and the habitat complexity increased along the transect. Silt, sand and rubble (35%) were common on horizontal surfaces and in low areas. Sponges (2%), encrusting sponges (10%) and coralline algae (probably 20%) were attached to silt-free and downward facing surfaces. Zoanthids (2%) and algae (1%) also occurred. Unidentified encrusting coral colonies (20%) (probably *Montipora* and *Porites*), *Diploastrea heliopora* (4%), plate-like *Echinopora* (4%), faviidae (1%), and delicately branching *Acropora* (1%) made up the live coral cover. Damselfish (pomacentridae) and a surgeonfish (acanthuridae) were noted on the transect.

MIDDLE HARBOR, STATION MH-6, 55-FOOT TRANSECT

At a depth of 55 feet the benthic cover was dominated by sand, silt and rubble (50%) that was most concentrated in narrow channels. Silt covered some limestone structures (5%). Sponges (1%), zoanthids (1%), filamentous algae (2%), and a fleshy algae (probably *Turbinaria ornata*) (1%) occurred infrequently. Encrusting coralline algae (maybe 20%) and encrusting sponges (maybe 10%) have consolidated some of the coral rubble. Encrusting coral colonies, mostly of *Montipora* (2%), appeared to be scarce, and a partial shield of *Diploastrea heliopora* (8%) provided the majority of the coral cover. Fishes observed on the transect included damselfish (pomacentridae), surgeonfish (acanthuridae), bicolor angelfish (*Centropyge bicolor* - pomacanthidae), and lizardfish (synodontidae).

MIDDLE HARBOR, STATION MH-7, 25-FOOT TRANSECT

At a depth of 25 feet, the habitat was dominated by silt, sand and rubble (65%) that was most concentrated in narrow channels. Silt also covered some of the low coral formations (15%). Coralline algae (10%), encrusting sponges (1%), sponges (2%) and soft corals (alcyonacea) (3%) mostly occurred on less silted substrates. Live coral was sparse with one colony of *Diploastrea heliopora* (3%) and one massive (30 cm) colony of *Montastrea* (1%).

Further onto the reef flat, there was more vertical relief due to some low areas that collected coral rubble (5%). Coralline algae (78%) remained the dominant benthic cover, but soft coral (alcyonacea) (10%) was common. Live coral cover included massive *Porites* (3%), *Pocillopora* (2%), and (possibly) *Astreopora* (2%). A speckled butterflyfish (*Chaetodon citrinellus* - chaetodontidae) was identified.

Closer to shore, there was a deeper sandy area (90%), but the remnants (about 1 by 1.5 meters) of a large shield of *Diploastrea heliopora* (10%) was seen.

MIDDLE HARBOR, STATION MH-8, 25-FOOT TRANSECT

At a depth of 25 feet the habitat resembled spur and groove habitat with the fairly complex coral structures (composed of massive, branching, foliaceous and columnar growth forms) interspersed with some areas of loose silt and rubble (35%). Silt also covered some of the hard substrate (3%). Two cans and a bottle (<1%) were seen on the transect. Large and small sponges (5%) were common, and coralline algae (30%) and (probably) encrusting sponges (5%) encrusted most silt-free surfaces. Live coral was limited to *Diploastrea heliopora* (5%), *Montipora* (<1%), *Fungia* (<1%), and unidentified branching (1%) and encrusting corals (maybe 2%). Fish observed in the area include many species of damselfish (pomacentridae), surgeonfish (acanthuridae), several wrasses (labridae), angelfish (pomacanthidae), and sabretooth blenny (blenniidae).

MIDDLE HARBOR, STATION MH-8, 40-FOOT TRANSECT

At a depth of 40 feet the habitat was dominated by rubble, sand and silt (65%), but some foliaceous and laminar structures occurred. A beverage can and a 55 gallon (fuel?) drum (3%) also occurred on the transect. Sponges (2%) were common, and coralline algae (10%) and encrusting sponges (4%) probably encrusted some of the silt-free substrate. Two colonies of *Diploastrea heliopora* (8%), a colony of faviidae (1%), a colony of poritidae (1%) with polyps extended (probably *Goniopora* or *Alveopora*), encrusting *Montipora* (3%), and unidentified encrusting corals (3%) were observed. Fishes observed in the area include damselfish (pomacentridae), surgeonfish (acanthuridae), goatfish (mullidae), wrasses (labridae), filefish (monacanthidae), and fusiliers (caesionidae).

MIDDLE HARBOR, STATION MH-8, 60-FOOT TRANSECT

At a depth of 60 feet the habitat was a fairly complex mix of massive, laminar and foliaceous structures, but a layer of silt (45%) covered most of the hard substrate. Silt pockets (10%) also occurred below the raised structure. Sponges (1%) were not common, but coralline algae (20%) and encrusting sponges (10%) probably encrusted some of the hard substrate. Live coral was limited to a single colony of *Diploastrea heliopora* (2%), unidentified encrusting and plate-like colonies (11%) (probably *Montipora* or *Echinopora*),

and perhaps a *Fungia* (<1%). Damselfish (pomacentridae) and butterflyfish (chaetodontidae) were seen.

OUTER HARBOR, STATION OH-1, 25-FOOT TRANSECT

At a depth of 25 feet, the nearly vertical reef face had caves and crevices of a variety of sizes. Silt and sand (5%) only accumulated on the protected horizontal surfaces. Sponges (5%), encrusting sponges (10%) and coralline algae (45%) were prevalent, and the non-scleractinian "pink lace coral" *Stylaster* (hydrocorallina) (1%) was commonly encountered on cave ceilings. Live coral cover was comprised of *Diploastrea heliopora* (2%), plate and encrusting colonies of *Montipora* (15%), *Porites* (5%) and *Acropora* (10%), and unidentified (2%) massive, digitate, plate-like colonies. Damselfish (pomacentridae) of the genera *Abudefduf, Stegastes,* and *Chrysiptera* were encountered on the transect, as well as striped bristletooth (*Ctenochaetus striatus* - acanthuridae), sabretooth blenny (blenniidae), and long-nosed butterflyfish (*Forcipiger* sp. - chaetodontidae).

OUTER HARBOR, STATION OH-1, 40-FOOT TRANSECT

At a depth of 40 feet, the reef face was sloping fairly steeply then became nearly vertical with many overhanging ledges and caves early in the transect. Sand and rubble (3%) occurred in a narrow chute, and a thin layer of silt covered (5%) some of the horizontal surfaces. The silt seemed somewhat consolidated by algae and hydroids. Coralline algae (60%) was ubiquitous, but sponges (3%) and the "pink lace coral" *Stylaster* (hydrocorallina) (3%) were only common under overhangs. Soft coral (alcyonacea) (1%) also occurred. Live coral cover included encrusting, plate-like *Montipora(?)* (20%), faviidae (1%), *Diploastrea heliopora* (<1%), and unidentified encrusting and massive colonies (3%). Fish observed on the transect were damselfish (pomacentridae), surgeonfish (acanthuridae), cardinalfish (apogonidae), pufferfish (tetraodontidae) and long-nosed butterflyfish (*Forcipiger* sp. - chaetodontidae).

The new transect marker stake was near a 3 meter diameter shield of *Diploastrea heliopora* and *Porites rus* appeared to dominate the slope just above the new stake. The old stake was encoutered about 20 meters into the new transect.

OUTER HARBOR, STATION OH-1, 60-FOOT TRANSECT

At a depth of 60 feet, the transect occupied two broad types of topography. The middle of the transect appeared to be a morraine at the base of the wall and the beginning and end appeared to be on the wall just above the morraine. Overall, a mixture of terrigenous silt and reefal sand covered rubble (43%) and coral formations (40%) and most of it appeared consolidated by hydroids and algae. Coralline algae (10%) and probably encrusting sponges (5%) encrusted some of the hard substrate, and sponges (2%) were common.

Damselfish (pomacentridae), surgeonfish (acanthuridae), and the yellowtail coris (labridae) were seen on the transect.

OUTER HARBOR, STATION OH-2, 25-FOOT TRANSECT

At a depth of 25 feet, the rugose habitat alternated with narrow channels of rubble and a little sand (1%) in one area. The consolidated coral and the rubble were mostly encrusted with coralline algae (60%), but sponges (1%) and soft coral (alcyonacea) (5%) also occurred. Live coral cover was dominated by encrusting colonies of *Montipora* (probably 20%), *Porites* (probably 5%), faviidae(?) (3%) and the non-scleractinian *Millepora* (hydrocorallina) (4%), but several *Pocillopora* (2%) colonies and one delicate branching *Acropora* (<1%) colony also occurred. Surgeonfish (acanthuridae) and damselfish (pomacentridae) were observed.

OUTER HARBOR, STATION OH-2, 40-FOOT TRANSECT

At a depth of 40 feet, the first three quarters of the transect was dominated by habitat that alternated between coral rubble and formations with fair complexity, and the last quarter of the transect was composed of very complex coral formations. Sand (5%) was present in low areas. Filamentous algae (<1%) and perhaps a diatom film occurred in the first few meters of the transect. Coralline algae (60%), sponges (1%) and encrusting sponges (5%) appeared to cover most surface in the first three quarters of the transect. Digitate colonies of probably soft corals (alcyonacea) (15%) were dominant in the last quarter of the transect. Live coral cover included faviiidae (1%), *Hydnophora* (1%) and *Porites lichen(?)* or *rus(?)* (1%), and unidentified encrusting and plate-like colonies (10%) that probably include *Montipora, Echinopora, Porites* and the non-scleractinian *Millepora* (hydrocorallina). An unidentified small starfish (asteroidea), damselfish (pomacentridae), wrasse (labridae), and surgeonfish (acanthuridae) were seen on the transect.

OUTER HARBOR, STATION OH-2, 60-FOOT TRANSECT

At a depth of 60 feet the habitat was less complex than at shallower depths with more rubble accumulations in the lower areas. Silt and sand (25%) also occurred in the lower areas, coralline algae (30%) encrusts some of the hard substrate, and a rope crosses the transect. Sponges (2%), encrusting sponges (maybe 10%) fleshy calcareous algae (1%) (probably *Turbinaria ornata*), and soft coral (alcyonacea) (1%) occurred on the transect. The live coral cover included a remnant colony of *Diploastrea heliopora* (1%), faviidae (2%), foliaceous, plate-like and encrusting colonies of *Montipora* (12%), *Acropora* (1%), and unidentified corals (5%). Damselfish (pomacentridae) and wrasse (labridae) were seen on the transect.

OUTER HARBOR, STATION OH-3, 25-FOOT TRANSECT

At a depth of 25 feet, habitat complexity was moderate and interstitial spaces were mostly small on the sloping reef face. Sand (35%) occurred in pockets usually under the coral formations, but sometimes in chutes and sometimes mixed with rubble. Refuse (1%) was represented by two beverage cans and a bottle on the transect, but other refuse was noted nearby. Coralline algae (20%) probably encrusted most hard surfaces, while sponges (<1%), soft coral (alcyonacea) (2%), algae (2%) were rare. Near the end of the transect, dense stands of calcareous, bush-like structures (8%) occur that may have been tubes of colonial polychaete worms (like *Filograma implexa*) or a calcareous red algae. The live coral cover on the transect was dominated by unidentified (20%) digitate, encrusting and plate-like colonies (that probably included *Porites* and *Montipora*). Identified live coral colonies included *Porites* (7%), staghorn *Acropora* (4%), and *Pocillopora* (1%). Large colonies of massive and digitate *Porites* occurred nearby. Surgeonfish (acanthuridae), filefish (monacanthidae), and many damselfish (pomacentridae) were seen on the transect.

OUTER HARBOR, STATION OH-3, 40-FOOT TRANSECT

At a depth of 40 feet the bottom was mostly sand and silt (45%) sometimes mixed with rubble with some silt-free coral formations that rose above it. Silt-free surfaces were encrusted with coralline algae (maybe 13%) and encrusting sponges (maybe 2%). Sponges (<1%) and filamentous algae (<1%), refuse (<1%) occurred on the transect, but were rare. Near the end of the transect, the bottom was dominated by dense stands of calcareous, bush-like structures (10%) that may have been tubes of colonial polychaete worms (like *Filograma implexa*) or a calcareous red algae. Live coral cover was dominated by massive and encrusting colonies of
Porites (25%), but some living staghorn *Acropora* (1%) branches that appeared to be broken off from a shallower colony, and some unidentified (3%) digitate colonies also occurred. Fishes observed on the transect included surgeonfish (acanthuridae), bicolor angelfish (*Centropyge bicolor* - pomacanthidae), the humbug dascyllus (*Dascyllus aruanus* - pomacentridae) and other damselfish (pomacentridae). Small and/or juvenile damselfishes appeared to take shelter among the digitate coral colonies.

OUTER HARBOR, STATION OH-4, REEF TOP TRANSECT

Between the stake marking the transect location at a depth of 25 feet and the reef margin, what appeared to have been digitate soft coral (alcyonacea) (70%) dominated the benthic cover. Encrusting coraline algae (15%), encrusting sponges (maybe 5%) and encrusting *Montipora* (10%) covered the remainder of the reef slope. The brown tang (*Zebrasoma scopas*) was among the surgeonfish (acanthuridae) seen in this area, and many juvenile parrotfish (scaridae), including bullethead parrotfish (*Scarus sordidus*), swam off the reef as the diver approached.

The complex habitat near the reef margin was dominated by stands of dead staghorn *Acropora*, but a few (1 meter diameter) patches were living (10%). Several other types of *Acropora* (10%) colonies were noted, including small branching and plate-like. Most surfaces were encrusted with coralline algae (maybe 80%). The bluebanded surgeonfish (*Acanthurus lineatus*) was among several species of surgeonfish (acanthuridae) that occurred in this area. Other fishes included damselfish (pomacentridae), goatfish (mullidae) and the birdwrasse (*Gomphosus varius* - labridae).

On the reef top, coralline algae (85%) encrusted dead stands of staghorn and table *Acropora*. The rolling topography continued across the reef top, and a little rubble and then sand (5%) had accumulated in some of the (3 meter diameter) low areas closer to shore. *Pocillopora* (5%) colonies were common and a few (2 meter wide) patches of algae (5%) were seen. Many surgeonfishes (acanthuridae), including the sailfin tang (*Zebrasoma veliferum*); many damselfishes (pomacentridae), including blue devils (*Chrysiptera cyanea*) and surge demoiselle (*Chrysiptera leucopoma*); and a large school of silver baitfish were seen on the reef top.

OUTER HARBOR, STATION OH-4, 20-FOOT TRANSECT

At a depth of 20 feet, the reef front was nearly vertical but complex with many caves, crevices and ledges. Some of the hard substrate in this transect occurred in partial caves and under large overhangs and was encrusted by coralline algae (maybe 40%), encrusting sponges (maybe 5%), and other organisms (7%). Sponges (5%) and "pink-lace coral" *Stylaster* (hydrocorallina) (<1%) occurred most frequently on downward facing surfaces. Encrusting colonies of *Montipora* (35%) dominated the live coral cover, but colonies of encrusting faviidae (2%) and small branching *Acropora* (3%) and encrusting unidentified colonies (2%) also occurred. In addition, unidentified colonies (5%) with a digitate and plate-like growthform may be *Porites, Montipora,* a soft coral, or a sponge. A blue devil (*Chrysiptera cyanea* - pomacentridae) and a sabretooth blenny (blenniidae) were among the fish seen on this transect.

OUTER HARBOR, STATION OH-4, 40-FOOT TRANSECT

At a depth of 40 feet the steep habitat was fairly complex with large and small caves and ledges. The middle of the transect crossed the mouths of 2 large caves with floors that were completely covered with sand (35%). Most of the hard substrate was encrusted with coralline algae (20%), encrusting sponges (5%), and an unidentified, knobby, pink organism (30%). Sponges (6%) were common, and the "pink-lace coral" *Stylaster* (hydrocorallina) (1%) was common on downward facing surfaces. Plate-like and encrusting colonies (probably) of *Montipora* (2%) and *Echinopora* (1%) were observed. Several small fish were seen but not identified.

OUTER HARBOR, STATION OH-4, 60-FOOT TRANSECT

At a depth of 60 feet the habitat ranged from complex coral structures (dead staghorn) to mostly sand bottom. The hard substrate was scattered over a mostly sand and rubble bottom (35%) with silt (20%) common on the hard substrate. Some refuse (<1%) was present (three ropes and a silt-covered beverage can). Coralline algae (9%) and a fleshy, calcareous algae (10%) covered some of the silt-free surfaces. Live corals included *Acropora* (5%), faviidae (<1%), encrusting *Montipora* (3%), unidentified encrusting corals (1%), and semi-foliaceous plates of (probably) *Echinopora* (9%). In addition, unidentified colonies (7%) with a digitate and plate-like growthform may be *Porites, Montipora,* a soft coral, or a sponge. Several species of damselfish (pomacentridae), several species of goatfish (mullidae), a snapper (lutjanidae), surgeonfish (acanthuridae), and a bicolor angelfish (*Centropyge bicolor* - pomacanthidae) were seen on the transect.

OUTER HARBOR, STATION OH-5, 25-FOOT TRANSECT

There was limited habitat complexity at a depth of 25 feet, but a number of caves, holes and ledges made some areas fairly rugose. The rubble was solidly consolidated by coralline algae (60%) and perhaps by encrusting sponges (5%). Sponges (5%) were common, and a soft coral (alcyonacea) (1%) was observed. Live corals include *Pocillopora* (5%), faviidae (1%), finely branching *Seriatopora* (or *Acropora*) (3%), and encrusting colonies probably composed of *Montipora* (12%), *Porites* (3%), and *Acropora* (5%). Surgeonfish (acanthuridae), moorish idol (*Zanclus cornutus* - zanclidae), lemonpeel angelfish (*Centropyge flavissimus* - pomacanthidae), reticulated butterflyfish (*Chaetodon reticulatus* - chaetodontidae), and many species of damselfish (pomacentridae) were seen on this transect.

OUTER HARBOR, STATION OH-5, 40-FOOT TRANSECT

At a depth of 40 feet the habitat was primarily consolidated coral rubble with some areas of ledges, holes and crevices that contributed to the fair habitat complexity. Solid surfaces were encrusted and loose rubble was semi-consolidated by coralline algae (65%) and encrusting sponges (maybe 6%). Most silt (15%) appeared to have been somewhat consolidated by hydroids and other organisms. Sponges (2%) were moderately common. Live coral cover was mostly encrusting or small, plate-like forms of *Montipora* (1%), *Porites* (1%) and unidentified types (10%). Many fishes were observed near the transect, including striped bristletooth (*Ctenochaetus striatus* - acanthuridae), damselfish (pomacentridae), parrotfish (scaridae), hogfish wrasse (*Bodianus* sp. - labridae), and a pair of bluefin trevally (*Caranx melampygus* - carangidae).

OUTER HARBOR, STATION OH-5, 60-FOOT TRANSECT

At a depth of 60 feet the slope was silt and sand (90%) covering most of the rubble and low, solid coral remnants. Coralline algae (maybe 8%) encrusted most of the silt free hard surfaces, but encrusting sponges (1%) may have also occurred. Live coral cover was almost non-existent, and only one unidentified encrusting colony (<1%) was recognized. Several types of damselfish (pomacentridae), filefish (monacanthidae) and several types of wrasses (labridae) were seen.